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COQUILLON'S INDICATORS.

For determining the existence of fire-damp in collieries the miner is in general simply guided by the nature of the small blue flame of his lamp when reduced to a minimum, which, however, varies according to the lamp in use. This method of operating is far from precise and furnishes unreliable results, most lamps giving no indications whatever when the proportion of noxious gas is below one, two, or even three per cent., and besides the height of the blue cone differs not only in lamps of different construction, but even in individual lamps of the same type. An eudiometric process can alone furnish exact results, but, as is well known, this is far from a practical operation. When it becomes requisite to analyse the gases of furnaces the difficulties encountered are still greater.

M. J. Coquillon, feeling the want of an efficient method for obtaining these results in a satisfactory manner, has invented an apparatus which he designates, according to the use to which it is to be put, as the grisoumeter (*grisou* being the French word for fire-damp) or the carburometer, the first for use in collieries, the second for furnace practice.

The principle of the instrument is based on the property of palladium wire, when heated, to burn the last traces of hydrogen contained in any carburet when supplied with oxygen for its combustion. The reduction in volume resulting from this combustion is proportionate to the quantity of the protocarburet, so that a properly graduated gauge furnishes at once the proportion of gas consumed.

The formulæ of this act of combustion are:

$$C^2 H^4 + 8O = 2\,CO^2 + 4\,HO$$
$$4 \text{ vol.} + 8 \text{ vol.} = 4 \text{ vol.} + 8 \text{ vol.}$$
$$\text{or simply } 1 \text{ vol.} + 2 \text{ vol.} = 1 \text{ vol.} + 2 \text{ vol.}$$

This is equivalent to stating that one cubic centimetre of protocarburet furnishes by its combustion one volume of carbonic acid and two volumes of steam, which last disappears in the shape of dew, so that for one volume of the burnt gas the reduction becomes equal to two volumes. It would be equal to three volumes if the carbonic acid were absorbed. One volume of bicarburet would give two volumes of vapor of water and two volumes of carbonic acid.

This principle being understood, we proceed to the description of the grisoumeter, two forms of which are made, the first for employment in a portable form for use inside the mine, the second more complete, and destined for the office or laboratory. Small bottles to carry air from the mine are used in connection with the latter form of instrument.

Portable Grisoumeter.—This consists of a central tube called the burner, Fig. 1, A, narrowed in the middle and graduated into spaces of equal capacity; the lower end is open, the top closed by an india-rubber stopper carrying two holders for the conducting wires, and whose lower branches press down the palladium wire. A third opening is left in the stopper to receive a small wooden plug or a glass rod. This first tube is surrounded by a glass sheath or cylinder B, closed at the top by a rubber disc having an orifice which closes by means of a plug. To the lower portion is adapted a diaphragm containing water, which is elevated or depressed by means of a screw on the principle of the Fortin barometer. Next to this first portion of the instrument is placed a second one, which consists of a Planté's condenser, the poles of which are attached to the two holders of the burner. A lateral screw acting by pressure starts the current and heats the wire at the desired moment. When an analysis is to be made, the inner tubes being full of water, the screw is lowered, so that as the liquid descends it is replaced by the air of the mine. The volume is so adjusted that the levels of both the tube and sheath are on the same horizontal line opposite the zero of the scale.

The burner is now closed while the outer sheath is left open. The electric current is started and the wire heated to redness. The gas is rapidly burned, and after giving time for cooling, the water is seen to rise more or less in accordance with the quantity of gas burned. The two water levels are readjusted by means of the bottom screw to equalize the pressure, and the division of the scale opposite the surface level read off. This instrument gives in one reading the amount of protocarburet in hundredths, but does not apply to quantities of the same exceeding five to six per cent. This would be useless practically, as at this point the miner's lamp is full of fire and he himself in the midst of a detonating compound. In order to determine by analysis higher percentages of protocarburetted hydrogen, or for more exact results, the stationary grisoumeter must be resorted to.

Stationary Grisoumeter.—The principle of this form of apparatus is based on Professor Deville's double flask. It comprises, first, a vertical glass tube, Fig. 2, A, or gauge, the top of which is branched in **T** shape, two cocks being adapted to the horizontal branches of the **T**. The lower portion of this tube is constricted and carries ten divisions, each of which may be subdivided into ten others; it is bent at right angles and attached to a rubber tube fastened to a flask used as an aspirator or blower. The capacity of the tube measured from the cock is 25 cubic centimetres, and the zero of the scale is indicated at the bottom. This is the point that must be reached by the gaseous volume when no protocarburet is contained in the instrument; 10 is marked near the bulge, each division being equal to ½ cubic centimetre. The second portion of the apparatus is the burner B, formed by a small thimble-shaped tube closed by a rubber stopper pierced by two holes into which are introduced the holders for the palladium wires. Laterally are adapted small capillary tubes which by means of rubber tubing allow of an attachment on the one side to the gauge on the other to the following bell glass. This last, C, is capped by a capillary tube bent at right angles and surrounded by a glass cylinder or sheath closed at the bottom and filled with water. The whole apparatus, as well as the corks, is in glass, and is mounted on a stout wooden board so as to protect it from accident. A small box containing 10 small tubes filled with water is accessory to the apparatus, these being filled when desired with the air collected in the various levels of the colliery and destined for analysis.

The use of the stationary grisoumeter is very simple. The bell glass surrounded by its cylinder is filled with water to a determinate or fixed point; the gauge tube is also filled with water. The burner and capillary tubes are left full of air. One of the small tubes from the box is now attached in such a manner that one end plunges into a tumbler full of water while the other or taper end is connected by means of a rubber tube to the anterior end of the gauge. One of Mohr's forceps closes this rubber tube at the desired height.

In order to introduce 26 centimetres of gas into the gauge, the left cock is opened and the forceps pressed by the right hand, while the left hand holds the flask so as to be able to raise or lower it at will. The gas passes from the conico-cylindrical tube into the gauge, and must be made to coincide with the zero of the scale as indicated by the water level. This being done, the left cock is closed and the right opened, and at the same time the palladium wire is heated to redness. The gas is made to circulate two or three times over the palladium by the motion given to the flask. After waiting until the burner has cooled down, the gas is returned to the gauge, and the scale read off. This last is so graduated as to indicate at sight 100th and 1000ths of protocarburet or of bicarburet. A few simple precautions are necessary in making use of the grisoumeter. The cocks must be often verified and greased to avoid leakage; the rubber tubes must be tightened on the glass tubes by thin brass wire twisted by means of pliers; the readings from the scale must be taken with the level of the flask and burner on same horizontal line. The spiral of palladium must be placed in the axis of the capillary tubes, three or four spires being sufficient according to the thickness of the wire. It is best to use water more or less impregnated with salt or hydrochloric acid to diminish the solubility of the carbonic acid resulting from the combustion.

A short practice with this instrument is all that is required to thoroughly understand its management. When the gaseous mixture to be analysed contains more than nine per cent. of protocarburetted hydrogen it becomes necessary to admit a supplement of air, so as to furnish the necessary amount of oxygen for complete combustion. When this addition is of a known quantity, a very simple calculation gives us the proportion of the protocarburet present.

Carburometer.—At the present time, when gas furnaces are taking so great a part in the economy of metallurgical processes wherever high temperatures are required, one of the most important problems to be solved is that relating to the composition of the gases contained in the fuel as regards their contents in carbonic oxide, hydrogen, and hydrocarburets, as well as of the constituents of the escaping gases which alone give us the measure of the degree of combustion operated. Until the present time no practical apparatus had been devised for a rapid and separate analysis of gases, so that M. Coquillon may be said to have rendered a service to metallurgists by this his latest invention, the carburometer.

The general principle of this instrument is the same as that of the grisoumeter, the hydrogen and hydrocarbons being determined by means of combustion in contact with palladium wire, while all the other constituents are absorbed by special solvents. The instrument comprises, as does the grisoumeter, a first gauge tube placed vertically, but having a capacity of from 50 to 100 centimetres, carrying at top a **T** capillary tube with a cock on the left branch. The right branch is prolonged horizontally, and has a cock at its extremity. Three vertical tubes, with cocks connect this horizontal tube with three bell glasses surrounded by cylinders in which absorbents are introduced. This same horizontal tube is attached to the burner, and is followed by a bell glass surrounded by its sheath just as in the grisoumeter. All these portions of the apparatus are mounted, like the other apparatus, on board for security.

The first bell contains a solution of potassa, the second pyrogallate of potash, and the third a solution of chloride of ammonia copper. The air must be excluded as much as possible from these solutions, which is best done by means of stoppers on the glass cylinders pierced by two orifices, one of which allows the passage of the reaction bell, and the other can be closed by a plug which is only drawn when an operation is performed. The solution of potassa will keep a long while, but the others need renewing when saturated and viscous. The best mode of obtaining the copper solution is by introducing a piece of copper wire cloth in the bell into a solution of chlorhydrate of ammonia. In the other bells small bundles of asbestos are placed in order to increase the surface contacts.

The analysis of a complex mixture of gases by means of this apparatus becomes quite an easy matter; the following gases being successively determined, viz., carbonic acid, oxygen, carbonic oxide, hydrogen, hydrocarburets, and nitrogen.

Let us take, say, 50 cubic centimetres of mixed gases and pass them successively through bell No. 1 containing the potassa; the carbonic acid will be retained; then through bell No. 2 to get at the oxygen, then through bell No. 3, which gives us the carbonic oxide. The carburets and the hydrogen remain yet to be determined. For this purpose we may take 25 cubic centimetres of the gaseous mixture and add 25 cubic centimetres of air if we have reason to believe in an insufficiency of oxygen for combustion, this we pass through the burner in contact with the incandescent

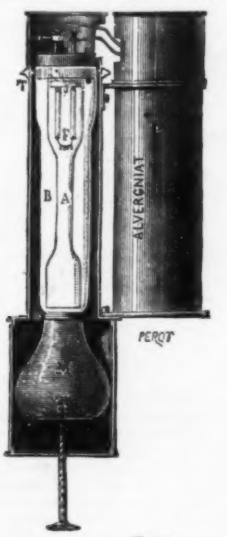


FIG. 1.

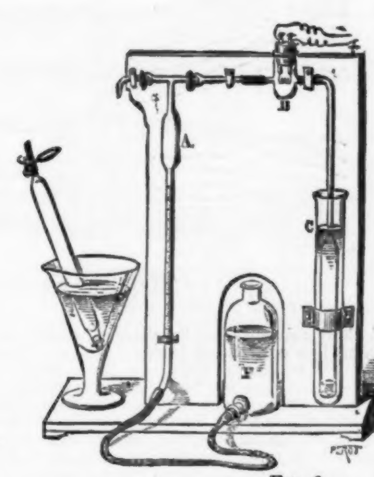


FIG. 2.

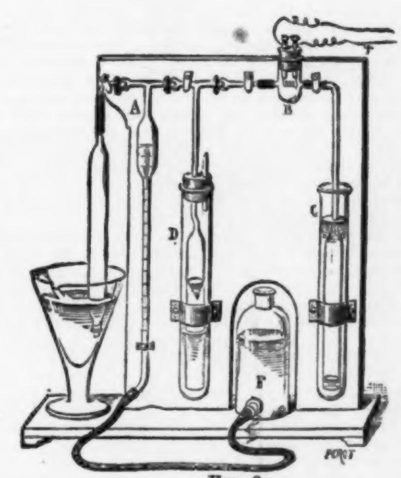


FIG. 3.

COQUILLON'S INDICATORS FOR NOXIOUS GASES.

palladium. Five to seven minutes later the diminution in volume will indicate the amount of water vapor, or of hydrogen, while the balance passed through the solution of potassa will furnish the carbonic acid. It is advisable to force the gas two or three times through the last bell and the potassa so as to be sure that all the carbonic acid has been expelled from the burner. The final residue can only be nitrogen.

Fig. 3 represents a carburometer with only one bell, this being its simplest form when carburets unmixed with other gases except air have to be determined.

The gases to be analysed are collected in suction flasks united to the source of production by means of a tube which must at first be deprived of the air it contains by means of an aspirator, after which it is united to the flask. This last is carried to the laboratory, and at once put into connection with the carburometer.

For heating the palladium, Bunsen elements may be used; but M. Coquillon prefers the secondary apparatus of Planté, this being sufficient for keeping up incandescence for six to eight minutes. With a small apparatus twelve to fifteen analyses can be effected, and when exhausted it can be charged anew by placing it in contact with a battery of four small Callaud cells, or the pole of two Bunsen cells, which may be charged once a week by simply placing pure water round the zincs. When employing Planché elements it is necessary to be very careful never to invert the poles, which is avoided by noticing the sign + near the wire, which is the one to be put in contact with the carbon or copper.

The grisoumeter has lately been practically employed with excellent results in several important collieries both in France and Belgium. There is no doubt that the fearful accidents in coal mines may be reduced to a minimum by the more general use of such an instrument, which any intelligent foreman can be taught how to manage in less than half an hour, and for which M. Coquillon has certainly deserved considerable credit.

In one of the collieries where experiments were tried only a few days ago, and where the miners thought themselves perfectly safe, 4 per cent. of gas was found at 4 ft. above the floor of the workings, and the mixture near the roof of the level was discovered to be of a highly detonating character, as shown by the grisoumeter.

At the Epinac collieries at Montceau lès Mines one of these apparatus is placed in every level of the mine, and a special man has been appointed to report the composition of the air four times during each shift to the mining superintendent. This example ought to be followed in all dangerous collieries.

As regards the practical and useful applications of the carburometer in the determination of the quantity of fuel, of the more or less perfect combustion of the same, of the quantities of air needed to be admitted for perfect utilization of the gases produced, and of the composition of escaping gases, they are too numerous for enumeration, but their importance will be fully appreciated by all intelligent metallurgists.—*Engineering.*

TORPEDO DEFENCE.

Fig. 1 represents an imaginary harbor defended by torpedoes, the presumed width of the navigable channel being about one mile, and the mouth of the harbor itself, say, two miles. The line of torpedoes marked 1, 2, 3, are placed across the entrance at a distance of from two to three miles from the town; each line consists of seven torpedoes, each of which should contain a charge of 500 lb. of compressed gun-cotton, and be placed so as to converge on one signalling or converging station; of course this station only becomes a necessity when it is desired that the torpedoes in question be so arranged as to allow of their being exploded either by contact or from the shore by observation. The firing and converging stations are connected by a four-core electric cable, one conductor for each line of charges, and the other for telegraphing. The telescopic arcs A A A, shown at the converging station, are each provided with a single fixed telescope which commands one of the lines of mines; while those shown at the firing station, and marked B B B, are provided with telescopes that are capable of being provided with telescopes that are capable of being revolved on their axis by means of a wheel and pinion arrangement, operated by a small mill-headed screw; each of these arcs are provided with seven sighting pieces—as described in a previous article—one sighting piece to each torpedo, fixed in a position corresponding to the position of the said torpedo as indicated by the telescope during the operation of mooring, and are connected so that one arc commands one particular line, and is in connexion with that line only; each arc at the firing station marked respectively 1, 2, and 3, being connected electrically with the arc at the converging station bearing that particular number, so as to include each individual line in a separate circuit, and thereby render firing by observation practicable. Each arc, both at the firing and converging station, is provided with keys for closing at will any particular circuit.

A signalling and shutter apparatus c with seven indicators —also described in a previous article—is attached to each telescopic arc at the firing station, and in connexion with the same individual line of torpedoes.

One battery of a hundred cells—modified Leclanché—is placed at the firing station, and is connected one pole to earth and the other to the firing terminal on the shutter and signalling and apparatus; but although attached to the apparatus it has no connection with the torpedo wires until one of the indicators fall. The dropping of the indicator arm may be effected either by the simultaneous action of the observers at the two stations, or by a vessel striking the circuit-closer in connexion with and floating above the torpedo. A signalling battery of two cells is also connected with the shutter and signalling apparatus, the mechanism of which is so arranged as to permit of the current charging all the conductors connected with it, yet no perceptible part must pass to earth without the circuit-closer being struck, when the full force of the current would instantly circulate, and trip the indicator arm belonging to the circuit closer struck, thereby switching in the firing battery current, and so explode the annexed charge. This system of firing may be in operation both night and day, but firing by observation can only be carried out in clear weather, when the approaching vessel could be clearly discernible with the telescopes of the firing and converging stations. Supposing an enemy's vessel were seen advancing in the line of torpedoes, but still outside the furthest line; the moment she covers one of the torpedoes, as observed through the telescope at the firing station, which must be moved rapidly from one to the other of the fixed sights that indicate the position of several of the mines, as often as the vessel changes its course, closing at the same time the key corresponding to the sight on which the telescope rests, and keeping them closed so long as she remains covering them. But the observer at the converging station would wait until the vessel came on his line, closing his key only when she was crossing; and if she did not cover any torpedo in passing, the operator at the firing station watching would have no key down, and consequently no torpedo would be fired. As in this case she would be passing through the space between two torpedoes, and advancing on the second line, the key of the second line would then be closed at the converging station, the effect of which would be the completion of the electrical circuit, providing the operator at the firing station had compressed the key corresponding to one of the charges situated in the second line, thereby tripping the indicator belonging to the torpedo named, switching in the firing battery, and so exploding the mine, the two observers simply acting the part of the circuit-closer when struck. Should the vessel, however, strike the circuit-closer before both keys are closed the explosion would be brought about independent of the operators, so that both systems of firing are in operation at one and the same time, each entirely independent of the other.

The channel is also guarded by a system of electro-contact torpedoes placed a mile or so in advance of the outer line of large torpedoes. In our diagram each of the two lines of torpedoes is shown connected with the firing station by means of two single-core cables, but it is also proposed to employ a four-cored cable running from the firing station, and terminating in a junction box, adjacent to the intended moorings, from which the branch cables, to which are connected the several short cables leading the charges, would extend; the remaining two cores being intended, one as a reserve in case it should be required at any time to throw out another line of torpedoes, and the other for establishing telegraphic communication between guard boats and the firing station during the night and in foggy weather. One great advantage in employing a vanguard of electro-contact torpedoes is that they save the necessity of expending so large a charge as 500 lb. of gun-cotton against minor vessels for the destruction of which a lesser charge would suffice.

A series of mechanical torpedoes are also shown guarding the flank of the electrical system, to which for this purpose they form valuable adjuncts. In the navigable channel, however, no torpedoes are employed save what are in connection with the shore, as it is absolutely imperative that they should be capable of being rendered safe for the passage of friendly vessels, and this can obviously only be effected by running the cables to the firing station and connecting or disconecting them at will with the firing battery.

Referring to the diagram under discussion, Y and Z are two strongly fortified positions from which the electrical torpedoes are controlled. At the converging station Z are three fixed telescopes A A A, one to each line of mines, and a Morse telegraphing instrument for sending and receiving messages to and from the firing station; while at the firing station Y are three telescopic firing arcs B B B, each provided with seven sights corresponding to the seven charges of one particular line, one arc, as at the converging station, serving for each line; three shutter signalling and firing apparatus C C C connected with the firing arcs and with the cablee in the manner shown on the diagram, four or seven strand copper wire insulated to five-sixteenths of an inch with india-rubber being usually employed for this purpose; a battery D of a hundred modified Leclanché cells; two cells E, Daniell's or medium size, ordinary Leclanché for signalling, one well-appointed "test table" with the necessary battery, five firing keys F F F F F, one test battery with galvanometer complete, one ordinary galvanometer, one frictional-electrical machine, one magnetic exploder, one magneto-electrical machine, one box of selected tools, two signalling lamps (Walker's patent), for each of which must be provided the following list of articles:

2 retorts.	1 oil lamp (reading).
1 wash bottle.	3 yards india-rubber tubing.
1 gas bag.	1 wrench.
1 pressure bag.	1 stove.
1 pair of lamp scissors.	1 case of potash.
1 box of lime pencils.	1 case of spirits.

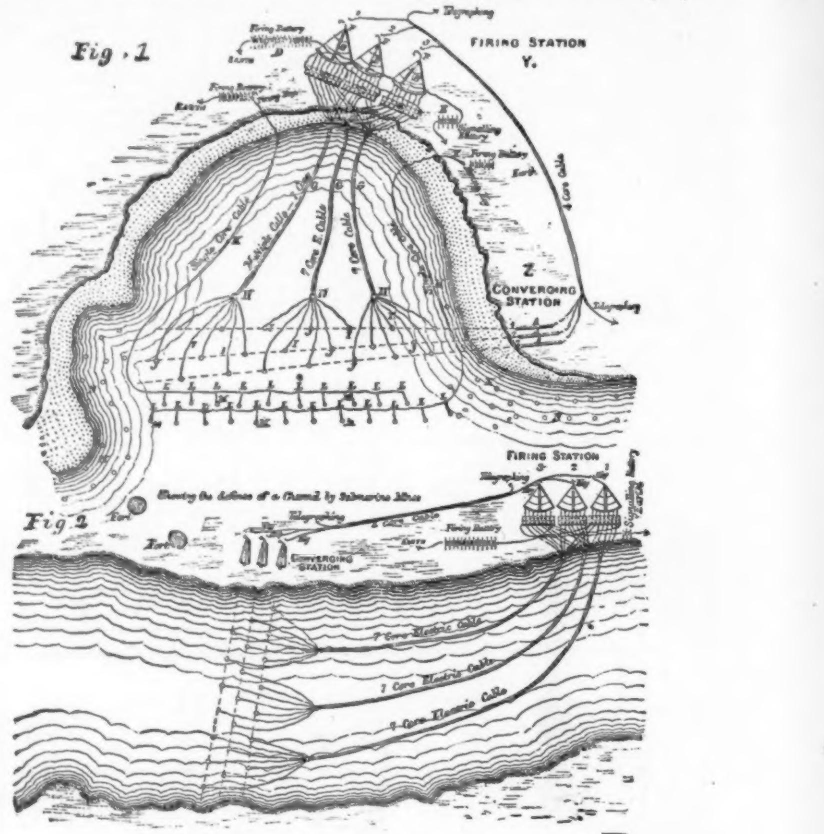
One portable tool chest containing the necessary tools for adjusting circuit-closers, etc., including one small plumber's stove, one soldering iron, one bottle of spirits of salts, a few sticks of solder, one small box of india-rubber solution, two rolls of india-rubber tape, one pair of pliers, and one hand knife, and, say, half a dozen military telegraph sounders. Referring again to our illustration, G G G are seven-core multiple cables, H H H are multiple junction boxes, I I I are single-core cables, J J J torpedoes, K K are also single-core cables, L L L T junction boxes, M M M electro-contact torpedoes, and N N N are mechanical torpedoes. The single-core cables K K may be connected to the large firing battery or to independent batteries according as the operator in charge may deem best. We doubt not but it will be more convenient to substitute for the two cables K K, one four core cable and junction box, as before alluded to, especially if they are to be placed at any considerable distance from the firing station.

Fig. 2 illustrates the defence of a navigable channel, heavy ground charges only being employed, arranged to be fired either by contact or by observation; the general arrangement is precisely the same as in the diagram just described, and need not therefore be recapitulated.

The instruments, etc., represented in the diagrams have been drawn to an exaggerated scale for the purpose of rendering the explanation more lucid.

In concluding this article on moored or fixed torpedoes, we have only to add that those interested in the torpedo question will now be in a position to judge of the possible efficiency of the approved appliances of to-day, and to see how needless are the fears expressed by sensational alarmists as to the presumable fate of our ironclad fleet in the maritime wars of the future. We do not, be it understood, wish to deteriorate in any degree from the merits of torpedo defence, or to underrate their value as obstructive agents; indeed we can unhesitatingly assert our belief that even should an enemy succeed in clearing a passage through them without any considerable loss to themselves—and we should certainly dissemble if we pretended to think that anything but the grossest carelessness on the part of the invaders could lose them a single vessel—the delay necessarily caused would more than compensate for the outlay expended on them.

There are doubtless many ways by which an intelligent commander could force a passage through even the most formidable lines of these submarine obstructions, without any very considerable danger to his ship. It will be sufficient, however, for our present purpose to call attention to three methods, which are as follows: First, the sending down of divers to search for and sever the connecting cables; secondly, the sending out of small craft, under cover of darkness, to grapple for and raise the torpedoes bodily from their anchorage; and, thirdly, the projecting of a guard of Bessemer steel wire, or other material, some 40 ft. or 50 ft. in front of the vessel's prow, supporting it, if necessary, with buoys; by this means the circuit-closer would be struck, the circuit closed, and the mine exploded, before the vessel was near enough to be anything more than severely shaken.—*Engineering.*



TORPEDO DEFENCE.

IMPROVED STEAMER LINES.

In the session of April, 1875, I read before the Institution of Naval Architects a paper on a form for ships, combining a high flat floor with vertical entry and after draught, the run commencing forward of the mid-length and the entry ending aft of it. In the discussion that followed, Mr. John Scott Russell said of one of the drawings that he could not conceive of a form uniting more good qualities.

I now send you [*The Engineer*] a drawing of the small cargo steamer Tagadito, of 135 tons dead weight and 6,000 cubic feet capacity which has given excellent results, though the system was carried out in her to but a limited extent, and the hull is coarsely, though strongly, built in this country. Her length at load line to screw post is 93 ft., her beam 18½ ft., and her depth of hold 8 ft., her engine has a

single cylinder of 11 in. diameter and 12 in. stroke, indicating, with 115 revolutions and 60 lb. pressure on boiler, under 30-horse power. The 4½ ft. screw was not made for her, but, with the machinery, was taken from a vessel of half her size. She consumes 1 to 1¼ tons of coal in 24 hours. With a displacement of 120 tons, she steamed four hours continuously on a trial trip, at a rate of over 6¾ knots, yielding, by the Admiralty formula, a coefficient of 196, that of her Majesty's frigates being but 165, according to the handbooks. This result I attribute to the "solidity" of the water in which the screw revolves, as the water feeds the screw directly, instead of having to find its way round a deep full floor. For in smooth water at a slow speed her fine lines forward would help her little; though with 100 tons weight of cargo on board, they enabled her to beat down the China Sea, 125 knots dead weight to windward in 36 hours, in a wind and sea against which a higher speed than 6 knots would have been useless. She takes no water on board forward, has never shown her screw above water or felt the pitch of a sea. Running with a strong breeze at 10 knots, her helm scarcely needs tending, though she can be turned so quickly as to appear made fast by the head.

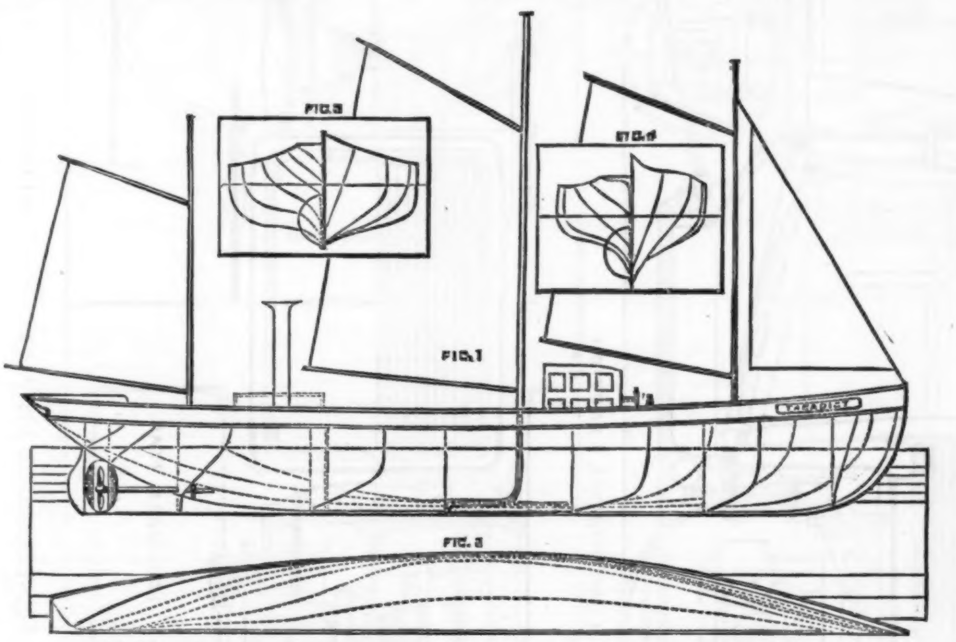
The form is evidently not that of least resistance in smooth water, but examination will show how much less than the usual form it would be affected by all the variations of wind and sea, by the absence of cargo, by its weight, or by its disposal; indeed, in vessels on this system, ballast would no longer be a necessity, and the difficulty of stowage would be reduced to the trim of the load line. With vertical sections forward to take head seas smoothly, the form solves the Admiralty problem of easing motion and raising weights without losing stability—the metacenter being raised with the center of gravity—and in doing this, as not only the weight, but the flat of the floor, is raised high above the keel, the water is allowed free course to the screw, as in the tunnels proposed by Mr. Griffiths, and, whether the vessel carry cargo or not, unequaled steering qualities are gained.

The Tagadito is built of wood, and the midship section in the drawing shows how the difficulty of shaping the timbers below was avoided by building up the garboards solid, giving great strength, but adding to the weight. In iron, the curves of the frames would present little difficulty, and bilge water would run into the interior channel, saving cargo and tonnage. The fineness of the lower part of the after frames is only limited by machinery space and strength of structure, and as far as regards stability there is no necessity to place the machinery low.

Fig. 3 shows cross sections of a Tagadito more to the system, with a 6 ft. screw and the flat of floor raised another foot. Beam is added to make up the displacement lost, the area of the immersed midship section remaining the same. The measurement capacity is much increased, and even the weight capacity, at the same proportion of reserve of buoyancy and safety. Fig. 4 shows cross section of a 72 ft. tug boat in contemplation, the small displacement admitting a still higher flat of floor, and a still larger body of undisturbed water to the screw; the result hoped for being a saving of a fourth or a third of the power ordinarily required to do the same work, our experience leading us to expect more from the density of the water by which the screw is fed than the power by which the screw is driven. Further particulars of the system may be found in the paper above alluded to.

EDWARD JACKSON.

Manilla, October, 1877.



IMPROVED STEAMER LINES. DESIGN OF EDWARD JACKSON.

ROTARY SUPERHEATED STEAM ENGINE.

THE invention of Mr. James Apperley, of Stroud, Gloucestershire, England, relates to rotary engines in which the steam is superheated during its passages to and through the engines, and the impulsive force of the elastic fluid moving with velocity is utilized. To this end the engine and superheater are combined in one, and consist chiefly of an outer stationary casing supported upon a suitable bed plate or foundation, or an inner revolving drum or cylinder mounted upon an axle carried from the bed plate. The outer casing is composed of two annular or serpentine concentric channels, or chambers, or passages, the inner one being the steam superheating chamber, and the outer one forms a part of the flue for the passage of the heated combustible gases, or it may be the chamber in which they are consumed. The entrance pipe or passage for conducting the steam from the boiler to the superheating chamber is commanded by a rotary or other valve rotated automatically. The inner periphery of the annular superheating steam chamber is formed by a series of partitions arranged tangentially, between which are parallel passages leading to the metal cylinder or drum, which is so mounted as to be capable of free rotation within this outer casing. This metal cylinder is provided with a continuous spiral or volute passage, which is composed of a series of alternate enlargements or contractions, triangular or pear-shaped in cross section. The opening or mouth of this passage is at the periphery of the cylinder, and is carried around the cylinder a sufficient number of times (approaching the center) to obtain the desired result—the expansion or condensation of the steam. The inner or open end of this spiral passage, which is near the center of the cylinder, commanded by a rotary valve or cock, may open out into a cooling chamber or condenser, so as to obtain the additional aid of a vacuum. The steam entrance and exit valves are operated automatically by means of cams or eccentrics on the axle of the cylinder or drum, and in any other suitable manner.

In starting the engine the communication between the furnace flue and the concentric heating flue of the engine is to be opened, or when the gases of combustion are burnt therein they are to be first lit, so as to heat the engine and prevent condensation of steam on its first admission; the ordinary saturated steam is then to be freely admitted into the annular chamber of the case, and, passing by the tangential passages, will enter in at one or more of the ports leading to the spiral steam passages, and, in its rush through them to the condenser or open air will impinge in succession on the heads of the triangular enlargements of the passage, and thus impart a rotary motion to the drum or cylinder by a rapid succession of impulses. When the outer case becomes heated by the passage through it of the combustible gases or the combustion of gases therein, the entrance and exit passages to and from the engine are to be allowed to be acted upon automatically; and the mechanism provided for this purpose is so arranged as to be capable of adjustment, both as to the number of times the valves are to be opened during one revolution of the drum, and the duration of time they remain open, so as to obtain the maximum effect due to the expansion of the superheated steam. In some cases it may be desirable to provide several entrances or mouths by which the first of the spiral passages may be fed from the tangential passages of the superheating chamber; one way of attaining this object is to cut narrow grooves in the periphery of the cylinder of a depth sufficient to enter or cut through some portion of the pockets leading to the first spiral passage. These grooves are to be of such a width as to obtain a wire-drawn action of the steam in its endeavor to enter the said spiral passages, and the frictional action of the steam will be necessarily in the direction of the rotation of the drum.

NEW GAS PROCESS.

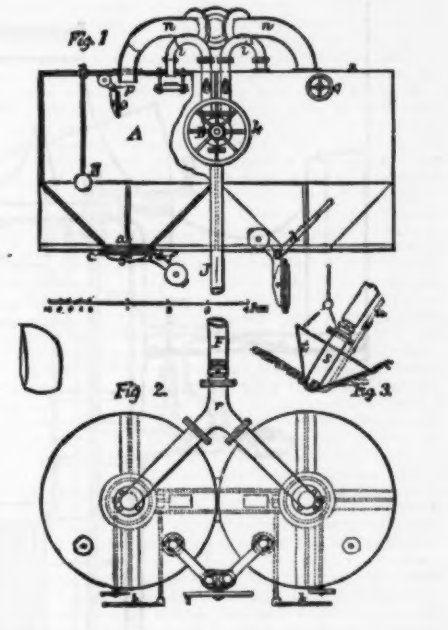
AN exhibition of Symes's process of making coal-gas was lately given in London in the presence of a large company of scientific men, both British and foreign. The advantages claimed for the process are that a greater quantity of gas is obtained, of a superior illuminating power; that the product is practically free from sulphur and ammonia, and that the manufacture can be carried on without annoyance to the neighbors and by unskilled labor. The necessary apparatus certainly occupies a remarkably small space, but it was said to be equal to supplying 50 lights. The main feature of the invention is that nearly all the tar is utilized. Instead of passing off into the hydraulic main, it is detained and thrown back into the retort, the gas passing through ingeniously-constructed purifiers, where it is freed from ammonia and sulphur. By this utilization of the greater part of the tar, the yield of the gas per ton of coal amounts to 13,000 cubic feet instead of 10,000, the usual amount from good coal mixed with a small proportion of cannel. Symes's gas is certified to contain less than 3 grains of sulphur per 100 cubic feet, whereas the companies profess their inability to reduce it below 25 grains, and only reach that standard with difficulty. The cost of making the gas is stated to be 1s. 6d. per 1,000 cubic feet, so that, allowing a liberal percentage for wear and tear and interest on capital, a considerable saving can be effected.

A FOUNDRY EXPLOSION.

AN alarming and fatal accident occurred the other day at the steel foundry of Terrenoire, Saint-Etienne. Just as the casting of an ingot of steel of 12,000 kilogrammes was being concluded, the ingot mould, filled with the liquid steel, was overturned into the moulding hole. The resulting contact of the molten metal with the water in a deep trench produced a violent explosion, followed by a large development of flame, in which four workmen were caught. The flame, which was quite instantaneous, lasted long enough to set fire to the clothing of these men, and to burn the uncovered part of their bodies severely. Three of the four died shortly after.

REEVES' EXCAVATOR.

THE employment of pumps in the excavation of sand and loose materials can now no longer be regarded as a novelty. Hitherto, however, in all applications of the principle of suction to this purpose the process has been slow in action, subject to frequent stoppages, and accompanied by severe wear and tear of the machinery, consequent upon the lifting and shifting about, and also admission of sand and grit into the valve chambers of the pump. In the system illustrated the danger from this cause is removed by keeping distinct and detached the air pump and the sand tank. It is kept entirely above water, with the exception of a suction pipe through which the soil is drawn. The greatest facility for working is combined with portability, as the machine, being entirely contained within one barge, can be towed or warped into harbor during bad weather, or moved about readily from place to place. When employed upon wall or quay foundations the same advantages are secured by placing the apparatus upon a truck running upon rails. In sinking cassions or cylinders by this



method, it is not necessary in order to pump out the water to place a heavy air-lock and other weights at the top, and to maintain a bell full of compressed air in the bottom, nor is it necessary to leave large hollow spaces and shafts in the masonry or concrete for the conveyance of men and spoil materials, as are required under the pneumatic method. Regularity of subsidence is secured by the use of a flexible sand pipe, which can be directed into any corner of the caisson of however irregular form. Rapidity in sinking may be obtained by building the caisson almost solid, for, as already stated, the usual large air spaces and shafts are no longer required.

Where the water is deep, and the cylinder to be sunk of small diameter, it is not necessary to carry the latter up above the surface of the water at once, but only to put together a length sufficient to prevent sand and silt from being washed into the cylinder by the scour of the currents.

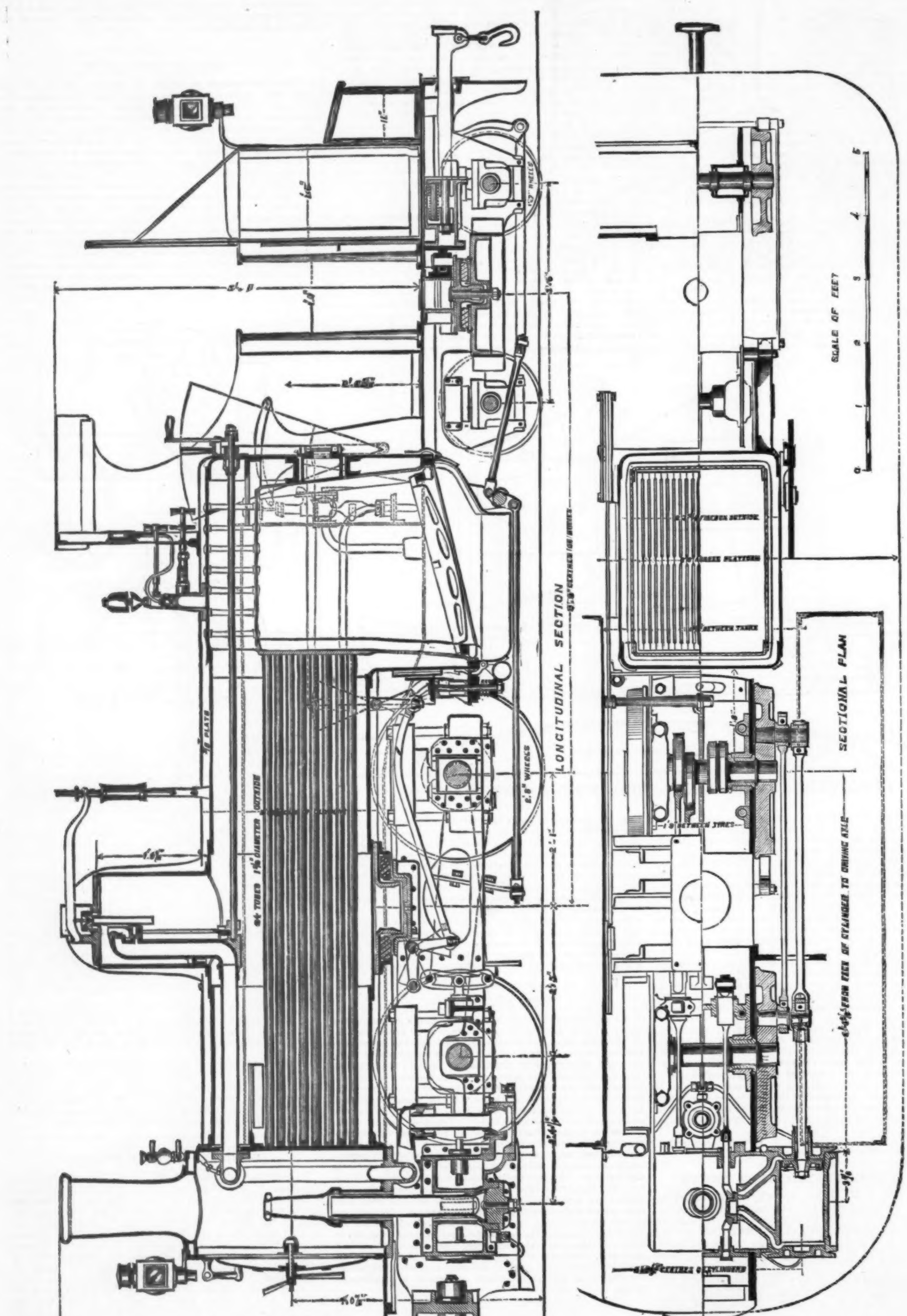
The apparatus has received a very extensive trial on the piers at the Tay Bridge, sixty having been sunk solely by this system. The foundations of these piers comprised in all 142 cylinders, varying in size from 6 feet to 31 feet 6 inches in diameter, and in some cases penetrating to a depth of 35 feet below the river bottom in 50 feet of tidal water.

It has also been adopted for the Severn Bridge, and on a very large scale by the North British Railway Company at Dundee in filling up the vast waste behind the Dundee Esplanade with sand sucked up from the bed of the River Tay.

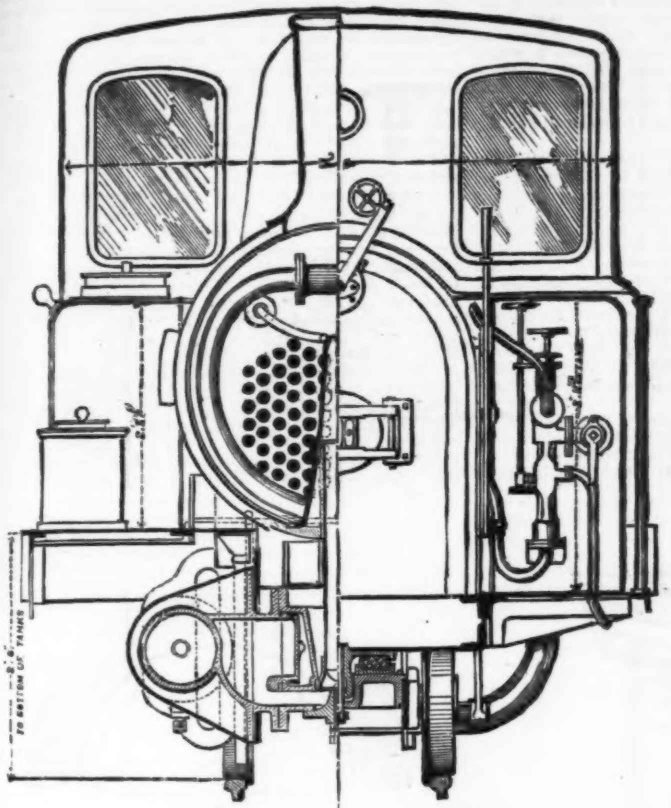
By the employment of small grouped charges of dynamite or lithofracteur chalk and clay can be rendered sufficiently fluid to rise freely into the pump. The effect of such explosives on those substances being to convert them into a pulpy, slimy state, and not, as in the case of harder rocks, to shatter them into splinters.—*Engineering.*

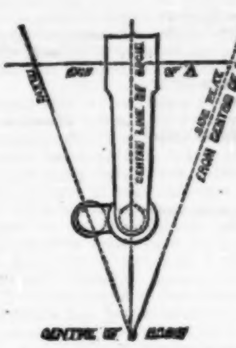
IMPROVED MACHINE PULLEY.

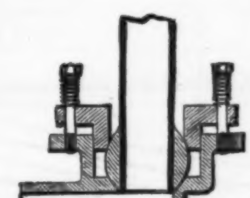
To overcome the difficulty and loss of time occasioned in fixing split or divided pulleys made in halves, an ingenious arrangement is proposed by Mr. J. Mackie, of Reading, which consists in the construction of the periphery and arms of the pulley, which may be made of wrought iron, steel, or other metal, and the arms may be made of various shapes or forms. The boss or center of the pulley is made in two pieces; into this boss the arms are inserted either by being cast, wrought, riveted, or screwed. The arms are made either of double or single bars of wrought iron, steel, or other metal, and are fastened into the periphery of the pulley. The periphery itself is split or divided, but has only one opening or division by means of which it is opened, and when this is done the boss is also opened sufficiently to place the pulley upon the driving shaft or spindle, the elasticity of the periphery giving a sufficient opening of the half split or division in the same, and also of the boss to enable this to be accomplished. This expansion or opening may also be accomplished by means of a bow or hinge in the opposite side of the opening in the periphery or rim of the pulley, as well as by its own elasticity



SINGLE-BOILER FAIRLIE ENGINE, FESTINIOG RAILWAY. G. P. SPOONER ENGINEER.



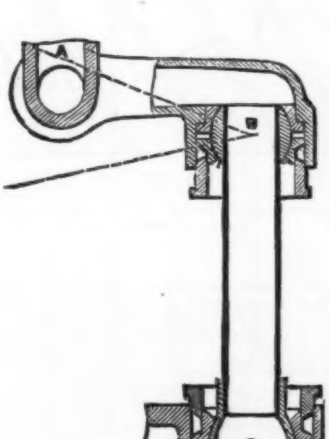




SINGLE-BOILER FAIRLIE ENGINE, FESTINIOG RAILWAY.

NEW NARROW-GAUGE LOCOMOTIVE.

IN our SUPPLEMENT No. 97 we gave a general elevation of a single boiler Fairlie engine, designed by Mr. G. P. Spooner, for working the Festiniog narrow gauge—1 ft. 11½ in.—railway. We now give detailed drawings. It will be seen that this is a double bogie engine, with steam cylinders attached only to the leading bogie. The bogies are connected as usual to a carrier frame by their centers, upon which an ordinary type of locomotive boiler rests, the leading bogie carrying the boiler and the trailing the tender part of the engine. The bogies turn on Adams' patent centers. The following are the principal dimensions:—Boiler: Length of boiler, 7 ft. 7 in.; diameter of barrel outside, 2 ft. 7 in. Fire-box: Length outside, 2 ft. 7½ in.; average height to crown inside from fire-bars, 2 ft. 10 in. Wheel base: Leading bogie, 4 ft. 6 in.; trailing bogie, 3 ft. 6 in. Tanks contain 380 gallons. The principal particulars are as follows: Cylinders, 9 in. diameter, 14 in. stroke; driving wheels, 32 in. diameter (solid cast steel); weight in steam, total, 15 tons; weight on leading bogie, 10 tons; weight on trailing bogie, 5 tons. Coal box holds 9 cwt. coal; working load up 1 in



80, 40 tons, at fourteen miles an hour. The baffle plate in the fire-box door is cast hollow in one piece, and perforated on the inner side, with an adjusting slide on the outside to admit air. All the mountings—viz., the two whistles, injector steam cock, Widmark's waste water cock, steam gauge, and cylinder lubricating steam cock—are all fixed on one general brass mounting in front of the cab connected to the boiler. The steam-pipe connections are differently arranged to those in general use. As shown in the accompanying diagrams, the vertical movement is taken by an elbow joint A, attached at the other end to a ball joint, which latter is on a stiff pipe with a ball joint at each end, and not telescoping as usual. A B takes the vertical movement from B as a center, the lateral motion being taken by B C, with B as a center. Although B is a suspended center, so to speak, supported by A and C, this arrangement works admirably. It may be stated that Mr. Spooner does not now use packing between the ball joint rings, but compresses the top ring with spiral springs, as shown. The plan has been at work for several years with success. The usual train for the engine consists of

	Tons cwt.	Tons cwt.
Six 4-wheel passenger cars at....	1 15....	10 10
One 8-wheel passenger car at....	7 0....	7 0
One 8-wheel passenger van at....	4 10....	4 10
Six 4-wheel coal cars at........	4 0....	24 0
		46 0

Coal cars weigh 24 tons, as above, or equal weight in empty slate trucks or coals in empty slate trucks. The train is often increased to 50 tons and sometimes reduced to less than 46 tons, making an average of 45 tons for three trips per day of nearly fourteen miles each, up one in eighty, returning only on the down trip with passenger cars weighing 22 tons. The average distance run per day is eighty-five miles.—*The Engineer.*

THE ROTATION OF THE EARTH AS A DRIVING POWER.

The source of the power of the tide mill or the principles concerned in its action would appear to be regarded as a somewhat involved subject—at least it is not generally treated of in the text-books. Mayer's view, as is well known (as given in Professor Tyndall's book "Heat a Mode of Motion," page 433) is that the power of tidal machinery is derived at the expense of the earth's rotation. This is shown by the following passage: "Supposing then that we turn a mill by the action of the tide, and produce heat by the friction of the millstones; that heat has an origin totally different from the heat produced from another pair of millstones which are turned by a mountain stream. The former is produced at the expense of the earth's rotation, the latter at the expense of the sun's heat which lifted the mill stream to its source."*

No explanation of the *mode* of retardation of the earth's rotation by the action of tidal machinery is given in Professor Tyndall's book, or apparently in Mayer's writings—though the mode of retardation of the earth's rotation by the *friction* of the tidal wave is very clearly explained. As therefore we think the subject has some practical interest, and fully admits of elementary exposition, we propose to say a few words on the subject in this article, having previously considered the matter carefully.

The phenomenon of the tide consists, as is well known, in an elevated mass or protuberance of water, situated (approximately) in the line joining the earth and moon, this protuberance of water not being carried round by the rotation of the earth; so that by this rotation, objects are carried through this elevated mass of water or tidal wave, dipping gradually below the wave at one boundary and emerging gradually from the wave at the other boundary, giving rise to what is called the rise and fall of the tide. It is well to keep distinctly in view that (neglecting the relatively slow motion of the moon and only taking into account the phenomenon of the ordinary diurnal tides) the tidal phenomena are not due to the rotation of the tidal wave about the earth, but to the rotation of the earth beneath the tidal wave which itself is stationary. Thus the rise of the tide on the beach is not due to the movement of the tidal water up the beach, but to the movement of the beach underneath the tidal water. It is important to keep this in view for the proper realization of the facts.

Let us suppose a reservoir carried round by the earth's rotation beneath the tidal wave, and let the reservoir freely fill and empty itself as it is carried along; then evidently there will be no work done in retarding the earth's rotation, and no work can be got by means of the reservoir. If, however, during the passage of the reservoir through the tidal wave, we impound a portion of the water and let the reservoir (by its rotation with the earth) carry away that portion of water in a direction from the tidal wave (*i. e.*, from the line joining the earth and moon), then this portion of water must be carried away in opposition to the pull of the moon which tends to retain it in the tidal wave, and since this carrying away of the water is done by the earth's rotation (carrying the reservoir with it), it follows that the earth's rotation is thereby retarded; just the same way as it would be if we imagine that the entire tidal wave had been compounded and carried round with the earth away from the line joining the earth and moon, which it tended to approach under the influence of the moon's attraction. What applies to the entire wave or mass of water applies to any portion of it, only the above extreme case may serve to put the fact of the retardation of the earth's rotation in a striking light.

If the water thus impounded be allowed to flow out of the reservoir and descend through a mill, then the power thus derived from the water is the exact equivalent of that attracted from the earth's rotation. If, on the other hand, the water be retained in the reservoir so as to come round (by the earth's rotation) to the tide wave on the opposite side of the earth, then (conversely) in the approach of the water in the reservoir to the line joining the earth and moon towards which it tends, work will be done by the moon in pulling this portion of water round, so that the earth's rotation will be accelerated by an amount precisely equal to the retardation in the previous case, and, therefore, on the whole no retardation of the earth's rotation will ensue. At the same time no work is got out of the impounded water; so that, therefore, it becomes clear, that in order to derive work from the water, the earth's rotation must be retarded, by an amount equivalent to the work derived.

To look at the same fact from a somewhat different point of view, we may suppose that, instead of impounding water, work is derived by raising a floating body by the tide. Then if the rise and fall of the floating body be not artificially resisted, it behaves exactly as the equal weight of water displaced by it would do, and at the same time no work is derived. But if the rise of the buoyant body be artificially prevented, then the earth in the act of rotation has to plunge this body below the stationary crest of water raised by the moon's attraction, and, in performing this act, the earth has its rotation checked by an amount equal to the work done in plunging the floating body below the surface of the water. The *mode* of retardation of the earth's rotation will, we think, be very clear and obvious in this example.

If, after the buoyant body has reached (by the earth's rotation) the highest crest of the tidal wave, and is there totally immersed, the body be then allowed to rise, then in this act the exact energy which was abstracted from the earth's rotation can be utilized for performing work. If, then, the floating body be allowed to sink freely again with the tide, no further retardation of the earth's rotation will ensue. But if the floating body be artificially confined at its highest level, or prevented from falling with the tide, then the rotating earth will do further work, for in the act of rotating it has to lift this body out of the water; or in other words, the rotating earth in transferring the body (which is not allowed to fall) from a portion of the tidal wave where the water is high to a portion where the water is low, has in that act to lift the body out of the water, for the body is no longer immersed at the part of the wave where the water is low. In this act of lifting the body the rotation of the earth is retarded by an amount equivalent to the work done in lifting.

If then, after the suspended body has been carried round by the earth's rotation to the boundary of the tidal wave (when the water is at its lowest), the body be allowed to fall, then work may again be derived from the body which exactly represents that abstracted from the earth's rotation in lifting the body out of the water.

The level of the water, it may be observed, is abnormally altered by the action of the moon. If it were not for this action of the moon, the surface of the water would always remain at the same level about objects on the rotating earth, and no immersion and emersion of these objects would take place by the earth's rotation; but on account of the abnormal elevation of the water opposite the moon, alternate immersion and emersion of objects necessarily takes place by the rotation of the earth beneath this elevation of water, and thus this rotation may be readily made to perform work.

Thus we observe that every operation of the tide mill takes energy from the rotating earth, and the inevitable conclusion follows that such operations, if continued long enough, would bring the earth to rest. The store of energy in the rotating earth is, however, so vast as to be practically inexhaustible by such operations in any time that we take account of. The rotative velocity of the earth's surface is such as to carry objects fixed on its surface, from the lowest to the highest part of the tidal wave (a distance of one-fourth the earth's circumference at the equator) in six hours, so that a lift can be obtained from the rotating earth (through the mechanism of tidal machinery) at every such interval. It would appear that this vast source of power were deserving of more attention than appears to be accorded to it, or that the problem of using the rotating globe as a driving power through the mechanism of the tide might be worthy of the attention of practical engineers.—*Engineering.*

*Mr. Robert Mallet questions this view (*Phila. Mag.* July, 1874.)

SAFETY GEAR FOR SIGNALS.

THE essential features of novelty in the invention of Mr. J. E. Etlinger, of the Great Indian Peninsula Railway, are that the gear is so constructed as to turn a signal on and off within a "minimum" space and time, and with an "interval" of rest between the turning on and the turning off of the signal. That applied to indicator signals of railway points, on a point being opened to "rather less than the maximum allowed wheel play of (say) "one inch," the indicator is instantly turned on to "danger," that it "remains so" till the opposite point rail is "within" the same distance of closing, and is not fully turned off to "all right" till such point rail is well home and the points safe. That whereas the turning of indicator signals generally in use is "proportionate" to the movement of the points which extends from 4 to 5 in., the turning by means of the improved gear is reduced to a movement of the points not exceeding 1 in., the signal, therefore, indicating "danger" so long as the points are not practically safe to cross. This improved action is produced by a crank plate with slot fixed to the signal rod (or stem), and acted upon by a pin working in the slot and forming part of the draw-bar or other gear in use. For the ordinary full points a crank plate with two slots and two corresponding pins are required, whilst for single slip or catch rails a crank plate with one slot and one pin only are necessary.

IMPROVED GRAIN-DRESSING MACHINERY.

MR. P. VANGELDER, substitutes for the cast iron an artificial stone made of pulverized French burr, united by cement. The cylinder formed for their composition, has, it is true, a smooth interior when new; but, after being at work for a few days, the natural grit of the stone exercises its full scouring power. This surface continues uniform throughout the whole thickness of the cylinder until completely worn away; but it is believed that one will last for several years. Another improvement consists in forming the cylinders with helicoidal V-grooves in the interior, which serve two purposes: First, they constitute a channel for the current of air drawn by a fan, so as to meet the descending grain, and thus effectually remove extraneous particles; and, secondly, they interpose a series of obstacles to the fall of the grain, and, by prolonging its descent, render the cleansing process more effectual.

The scouring case is cast in two semi-cylinders, which as they come from the same carefully constructed mould fit together exactly. The exterior is lagged with wood battens like a steam-boiler, for the sake of appearance, the whole being secured by hoops drawn together by bolts. Inside this fixed casing revolves a vertical drum of cast iron, coated with "stabbed" steel, which is easily renewable when worn. Between these two faces—that is to say, the periphery of the drum and the interior of the artificial stone cylinder—the grain is introduced, when it is dashed against the casing by the centrifugal force and then thrown back upon the drum owing to the V-grooves, this action being sucked upwards, some of the heavier being deposited at D, while the remainder are drawn up by the upper portion, *g*, of the fan, the intensity of its action being regulated by the sliding-valve, E. The grain from the upper part of the fan-case, together with the particles drawn off from the lower part, are blown against the deflecting plate, J, which gives them an inclined upward direction, and then, almost at right angles, against another plate, I. These deflecting plates can be adjusted so as to effect the desired result, viz., to direct the better offal into the shoot *k*, while the refuse is blown off at G.

Fig. 2 represents a half horizontal section through the drum, revolving in the direction shown by the arrows, and the stone casing. The dotted lines indicate the course given to the grain. Owing to the centrifugal force created by the revolving drum, each grain flies off at a tangent and strikes the opposite face of one of the grooves, *x x* (fig 1); from this it rebounds on to the other face, whence it is deflected on the drum, again to be thrown off and again to rebound in accordance with the law of reflection.

Fig. 3 shows the development of a portion of the interior of the grooved cylinder. The theoretical path of a grain is indicated by the zigzag lines; if the current of air caused by the fan be strong, and the feed slight, the line approaches the straight, as *a a*, but if these conditions be reversed, the line may be represented by *c c*.

Two machines were shown in action, says *Iron*, at the Royal Agricultural Show, Liverpool, by the manufacturers, Messrs. Walker and Pendleton. The medium size of the five made was driven as shown in fig. 1, and had a separator

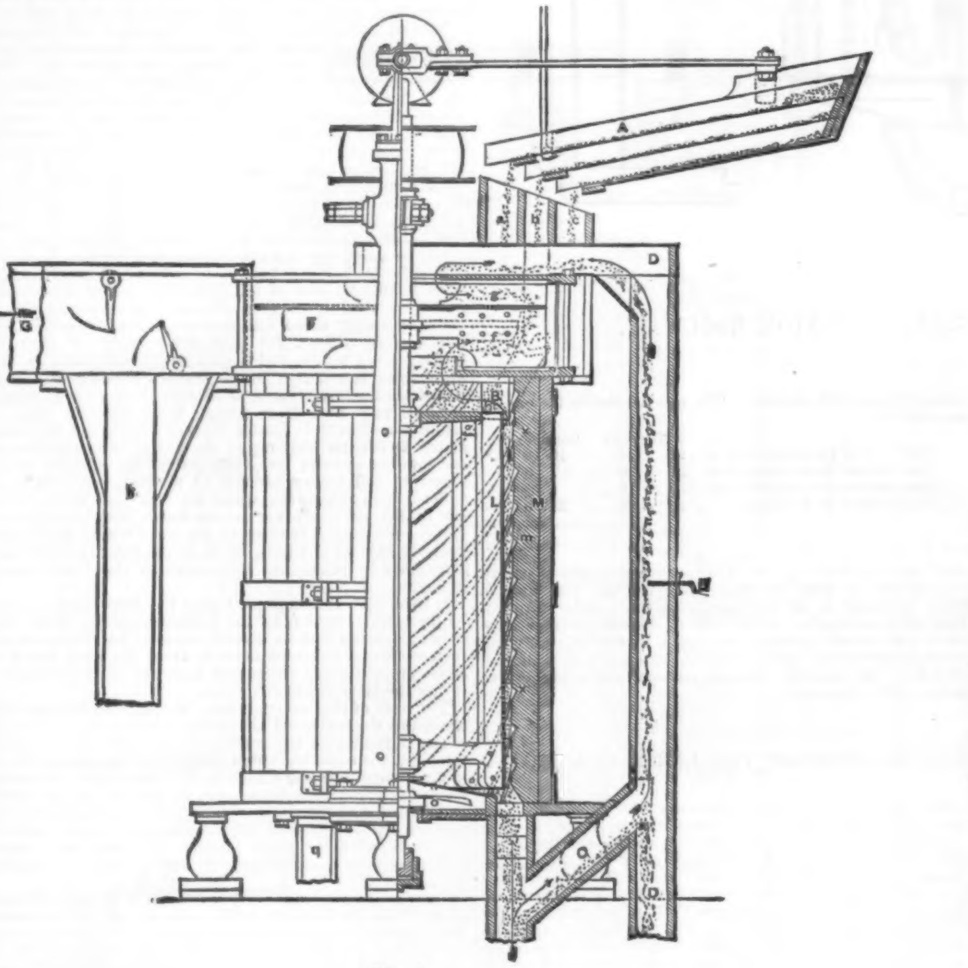


FIG. 1.

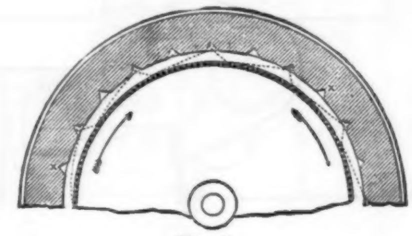


FIG. 2.

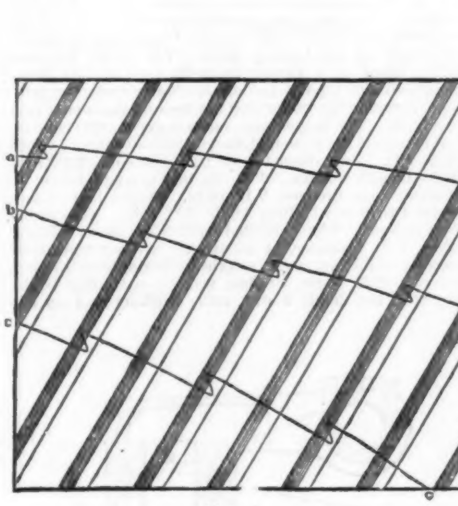


FIG. 3.

VANGELDER'S IMPROVED GRAIN-DRESSING MACHINERY.

prolonged by the upward current created by a fan, which exerts a double action, while the grain is delivered cool, clean, and free from those impurities which deteriorate the meal.

Fig. 1 of the accompanying illustrations shows a half elevation and half vertical section of the improved corn-dresser and smut machine. The fixed cylinder, M, lined with the artificial stone, *m*, is supported by a strong cast-iron frame. Inside this cylinder revolves the drum, L, covered with stabbed steel, *l*. The drum spindle, running in suitable bearings, carries at its upper end the fan, F, divided by a disc into the upper portion, *g*, and the lower portion, *f*. The latter is in communication with the space between the drum and the casing, and the former with the suction and deposit pipes, C and D. The fan case forms a continuation of the artificial stone casing and communicates with the outlet conduit, G. Above the driving pulley on the spindle are a pair of bevel wheels, which, by means of a crank and rod, give a reciprocating motion to a triple screen or riddle, A.

The grain is fed from a hopper on to the screen; the large impurities are arrested on the top portion, and fall through the spout *a*, while the small seeds are ejected from the bottom portion through the spout, *c*. The corn falls from the middle portion through the conduit, *b* (shown partly in dotted lines), into the space between the drum and the casing. Here it meets the current air due to the lower portion of the fan, and in due time arrives at the bottom of the casing. Some of the smaller seeds not separated by the riddle pass through the screen, *n*, and are carried round by the scraper, *o*, to the outlet, *g*. The grain leaves the cylinder by the vertical conduit, which also serves for the inlet of the current passing between the drum and the casing, and is deposited at the mouth of the suction pipe, C, where any light particles not drawn up through the grooves are or sifting apparatus attached; but the smaller, fitted up for scouring and polishing coffee berries in the same way as for corn, but with a slight difference in the construction of revolving drum, was driven by bevel gear and a belt. Mynheer A. Huet, lecturer at the Polytechnic School, Delft, after seeing the new corn-screener in operation, reported favorably on its action; and several practical millers have given testimony to its advantages.

CENTRAL AMERICAN TIMBER.

THERE are in Honduras, and other Central American States, many useful and beautiful woods not generally known here, but which are admirably adapted for building, inside finish and cabinet work, such as acacia, a very durable, hard, brown wood, used for house posts, piles, etc.; alligator pear, a very durable brown wood, but not abundant; wild hazel tree, used with success for building purposes; balsam tree, measuring from 12 to 15 inches in diameter, with a red, close, hard wood, suitable for building, and used for rollers in sugar mills; bullet tree, large, with hazel brown wood, close and hard, used for building purposes, and very durable: cabbage or partridge tree, close and hard, and of a brown color. This last is very durable, withstands the action of water, and is of much value for sleepers and bridge timber, also shipbuilding and cabinet work. Camphor wood is used for house posts, bridge timber and sleepers. It is a large tree, which grows to about 24 inches in diameter, with a coarse, soft, stringy wood. When newly cut it has a pleasant odor, is very durable, and stands the wet like few other woods. Cedar grows to a large size, and, in Honduras, is used for house building. Four to six feet in diameter is frequent.—Cotton tree grows to a diameter of eight to twelve feet. The wood is whitish yellow, light, not very durable, but easily worked. For inside work it would probably be found a good building wood. Billyweb is a tree growing from 12 to 16 inches in diameter, with a brown colored wood, very elastic and one of the most valuable woods where durability, toughness, and, in fact, any of the qualities of the lignumvitæ are required. It is used for bridge timbers, house posts, trenails, machine frames, etc. Dogwood, a hard, dense, brown, durable wood, is much esteemed for shipbuilding, knees of this timber being very durable. Live oak does not acquire a large size here, growing seldom to more than 16 inches in diameter. Used for sleepers, house posts, etc.—Fustic is best known in this country as a dye-wood, but is used in Honduras for building purposes and also in shipbuilding; and rosewood is too well known to need notice here. Redwood is used in house building and for any work in the ground. It is a middling sized tree, growing to about 16 inches in diameter, with a dense, hard, red wood, and very durable. Black mangrove, dark, hard and tough, is very durable, dense and heavy, and is used for such purposes as piles, sleepers and house posts. Red mangrove is a red, hard, elastic, straight-grained wood. It is used for house building, and is very valuable in the ground and water. White mangrove is a tree with a white wood, and though not very durable, is used for dry work in house building, and answers for such purposes very well. Mahogany, too well known to need description, is used in Honduras for house building, bridge timber and shipbuilding. Sapodilla is a tall tree, with dense, hard, red wood, and is very durable on land or water. It is used for building purposes, rollers for sugar mills, and for eccentric turning. Pine, yellow, or pitch pine, is very abundant. The wood contains a great quantity of turpentine and is very durable in and above ground as well as in the water. It is used for building purposes, piles and shipbuilding. Oak resembles that of England and grows on high ground, above the lines where pines grow.—San Juan is a tall tree, growing to above two feet in diameter, with a light yellow wood, very durable for dry works and used very extensively for building purposes. Santa Maria is a tall tree resembling mahogany, of whose character it partakes. It is, however, of more density, of a dark brown color, and very durable. It is considered a very valuable wood for shipbuilding and is one of the best woods known in Honduras for wet works—as piles and foundations—as well as for machinery, frames, rollers, etc., as it contains no acid, is cross grained, not brittle and very resisting. It is abundant at a short distance from the coast. Savicer is a large tree, with a heavy, red, durable wood, of the dark mahogany character. This wood is highlp esteemed for shipbuilding purposes, bridge timber and sleepers. Seaside grape is used for building, sleepers, knees and also for eccentric turning. It always grows in the vicinity of the sea, with a dark red, fine grained, hard wood, which is very durable. Lancewood is principally used for cart shafts. It grows from three to six inches in diameter, is of a pale yellow color, and very elastic. Yellow-wood is a middling sized tree, up to 16 inches in diameter, with very little sap, the wood light yellow, and close grained, somewhat resembling boxwood. It contains a yellow dye, but in smaller proportion than fustic. It is used for building, and might possibly be used for engraving.

DRAWING PLATINUM WIRE

M. A. GAIFFE finds that if atmospheric dust is carefully excluded during the operation of drawing platinum wires, the wire is more tenacious.

THE SALT MANUFACTURE OF MICHIGAN.

By S. S. GARRIGUES, PH. D.

HISTORICAL.

IT was known from the earliest settlement in the country, that the Indians formerly supplied themselves with salt from springs existing in the peninsula, and numerous reservations of land supposed to contain the springs were made by the general government, and it is a matter of record that many years before Michigan was organized into a State government, attempts were made to manufacture the article.

By the act of admission of this State into the Union, in 1836, it will be recollected, the State authorities were permitted to select seventy-two sections of salt-spring lands.

A State geologist—the lamented Dr. Douglas Houghton—was appointed at the first meeting of the Legislature thereafter, who, in his report to the Legislature in January, 1838, says he regarded it important that the spring lands be selected for State purposes, at as early a day as possible, and most of his examinations the season previous were devoted to that end. Dr. Houghton's explorations resulted in finding many indications of saline springs, particularly on the Grand and Tittibawassee rivers, in Kent and Saginaw Counties, and also in St. Clair, Macomb, Wayne, and Jackson Counties. The Legislature passed an act for the improvement of the State springs in 1838, and by virtue of his appointment, Dr. Houghton was authorized to make examinations and to institute experiments, which he did on the Grand and Tittawabassee rivers with partial success.

Although public attention was at that time directed to our salt springs, and practical investigations relating to their development were for a time vigorously prosecuted, these experiments failed of complete success, and the subsequent death of Dr. Houghton, by depriving the State of one on whom it had relied to give intelligent direction to these enterprises, discouraged in a measure their further prosecution.

Guided, however, by the information thus furnished, other investigators took up the matter, and on a thorough examination of the subject became so fully satisfied of the existence of rich saline waters in our State, that they at once determined to extend their experimental researches still further, and soon demonstrated in the most satisfactory manner the entire correctness of the theory advanced.

Saginaw Valley has the honor of having practically proved the wisdom of our first State geologist, in regard to the saline resources of the State, and demonstrated in a few short years, to an extent hardly to be credited, their unlimited supply, as well as their profitable and beneficial nature. Encouraged by the information furnished by the geological surveys, borings in several localities have been extended to other groups of rocks, much older and lower than the preceding, viz., Onondaga salt group—the representation in this State of the group so called in the State of New York—and though their productiveness is not yet perhaps satisfactorily established, sufficient encouragement has been received to afford reasonable hopes that these rocks may yet yield a supply of salt sufficient to render them a source of profit, thus adding immensely to the saline wealth of the State.

WELL-BORING MACHINERY.

The proper location having been selected for the salt well, a drill house, 16 by 30 feet, with a tower, is erected. This is large enough for a boiler, small portable engine, and a forge for repairing tools and keeping the drill sharp.

The tower or derrick has a height of 50 feet, or is high enough to draw out the drilling poles. The tool with which the boring or drilling is done is a drill, 3 feet long, shaped at one end like a chisel, and made of the best quality of steel.

The drill is screwed into the sinker, which is a round iron bar 40 feet long and 3 inches in diameter and weighing about 2000 pounds.

Attached to the sinkers by strong screws are the "jars;" these are about 7 feet long and made of good iron. The "jars" are two slotted links, moving up and down within each other, and are intended to increase the force of the blow of the drill upon the rock by allowing it to fall with a sudden jerk.

The jars are attached by a screw to the drill pole, which is, in turn, connected by a swivel to a chain. The chain is fastened to an ordinary "walking-beam" of wood, driven by an engine of small horse-power.

The beam rises and falls continually over the mouth of the well, the chain which suspends the tool passing over the end of the beam, being so arranged that it can be let out as the hole deepens, at the same time lifting the tool or drill and allowing it to drop with measured stroke on the rock, which is thus gradually drilled out. A workman sits at the mouth of the well, having the pole grasped by his hands, and after every stroke the poles are slightly turned so as to turn the drill which is working on the bottom, thus keeping the well true and circular in shape.

While the well is in process of boring, the tools are frequently removed and the sand pump introduced to remove the loose matter from the bottom of the well, which is done by means of a suction valve. The sand pump removes all the ground rock sand, and takes up at times stones an inch or more in size. In commencing the well, a strong wooden box 8 inches square, made from 2-inch plank, is driven down into the ground, say from 14 to 16 feet. Inside of this, an 8-inch iron tube or casing is put down as fast as the alluvial or drift material overlying the rock formation is broken up by the drill and taken out by the sand pump; this continues until the solid rock is reached.

At this point, considerable care should be taken that the opening into the rock is perfectly round and well finished by the drill; for the casing should be set so firmly in the rock as to prevent any sand or gravel from running in under the tube, and thus getting in on top of the drill and endangering its becoming fastened in the wall.

The rock-drilling now commences and continues to the depth to which it is proposed to sink the well. After drilling is done, the sides of the well are smoothed off with a tool called a reamer.

In most of the salt wells on the Saginaw river an offset is placed in the well at a short distance above the lower sand rock. Below the offset the size of the well is lessened half an inch in diameter.

On this offset is made the so-called rock-packing, the hole being drilled bevelling so as to receive a tightly-fitting iron collar or funnel-shaped piece of metal. A tube corresponding to the size of the upper part of the well is made to rest on this rock-packing as the offset and runs to the top of the well; in this way, all the weak brine from the upper rock and any fresh water that may come into the well above the offset are shut off. Below the offset, the tube continues in reduced size to the locality of the lower sand rock, at which point the pumping chamber containing the pumping valves are placed.

In the early history of the salt-well boring in Michigan, the pressure of the brine in the well tube forced it within 100 feet of the surface. More recently, owing no doubt to the great demand for brine, it does not rise so high. It only requires a small amount of power, after the pumping rods are properly balanced, to lift the brine out of the well into the settling tanks.

PUMPING BRINE.

Often, in starting a new salt well, the brine is weak—that is, shows a small percentage of salt by the salinometer. This arises from the fact that a large quantity of fresh water or weak brine from the upper formations has passed down into the well during the time the well was opened or being tubed. To test this point, and to bring the brine up to the usual strength of salt brines, the pump is put in operation and run for some time. If the brine continues to show an increase of strength on being tested by the salinometer, the pumping is continued until the strength of brine remains permanent at such a percentage as wells of equal depth in the same locality have shown.

If, however, the brine does not increase in strength, there are strong probabilities that there is a leakage of fresh water or weak brine into the well at the offset. This should be remedied at once—the more so if the well is a deep one, such as most of those in the Saginaw Valley are; for in this case the offset in the well is below the so-called gypsum formation, and you are drawing in and mixing with your strong brine a weak brine from these formations, which has a higher percentage of gypsum.

This mixing of the two brines in the well and tubing causes a precipitation or separation of the gypsum upon the pumping rods and in the pumping chamber. If this is not stopped, it will eventually close up the valves, and prevent them from being drawn out of the chamber. More than one instance has been known where parties have suffered much extra expense in not attending to this kind of leakage.

A manufacturer, in starting up his well pump, may also find that he has a short supply of brine, and the brine in the well tube runs down as soon as the pump is stopped. In this case he may have strong suspicions that his well tube is defective, or that the joints are not put together tightly, causing a leakage. To ascertain where this is, the tubing should be lifted out; the lower valve being allowed to remain in. As the tubing is being drawn, the pressure of the column of brine in the tube on the joints or imperfections will show where the leakage is. If the tubing is imperfect, it should be taken out and replaced by perfect tubing. When the leakage is at the joint, a new thread should be cut upon it, or the joint should be screwed together more tightly.

It is very important that the salt manufacturer should ever be on the lookout for these leakages, as they may and do often arise from a jarring of the tubing in running the pump faster than the supply of brine comes to the pumping chamber, causing a vacuum and producing the so-called pounding of a well. The capacity of a well has been very materially affected by such a leakage, increasing the expense of pumping from 50 to 100 per cent.

The supply capacity of a well is also very materially increased by the position of the pumping chamber in the well. In the early history of salt wells in Michigan, the pumping chamber was generally placed a short distance below the offset. More recent tests go to prove that the best location for the pumping chamber is at or very near the point where the largest supply of brine comes into the well, and that point is the lower portion of the sand rock, or within a short distance of the bottom of the well.

In pumping a well, it is also important that the weight of the pumping rods should be evenly counterbalanced by a weight on the other end of the walking-beam; this relieves the engine, the only weight to be lifted being the brine.

The stroke of the piston in the pumping chamber should be made as long as possible, and the motion of the engine should not be over 32 revolutions to the minute. In this way, about the entire supply of brine in the well is obtained, without forming a vacuum, thus preventing the pounding of the well and the danger of parting the pumping rods or jarring the tubing loose at the joints, causing leakage.

The capacity of salt wells varies in different localities, from 12 to 20 gallons per minute—the size of the well and the quantity and porosity of the sand rock having much to do in increasing the amount. A good well will fill a cistern 20 x 30 x 6 feet in about 20 hours. A salt well in Saginaw City, owned by Pierson, Wright & Co., produced enough brine during a manufacturing season of eight months to make over 16,000 barrels of salt. At East Tawas, the wells, 3½ inches in diameter, fill a cistern of the above size in about twelve hours. At Port Austin, the well fills a cistern in seventeen hours.

RECEPTION AND SETTLING OF BRINE.

The salt manufacturer having satisfied himself in regard to the quantity and quality of the brine supply, must now be prepared with cisterns to store his brine during the process of settling.

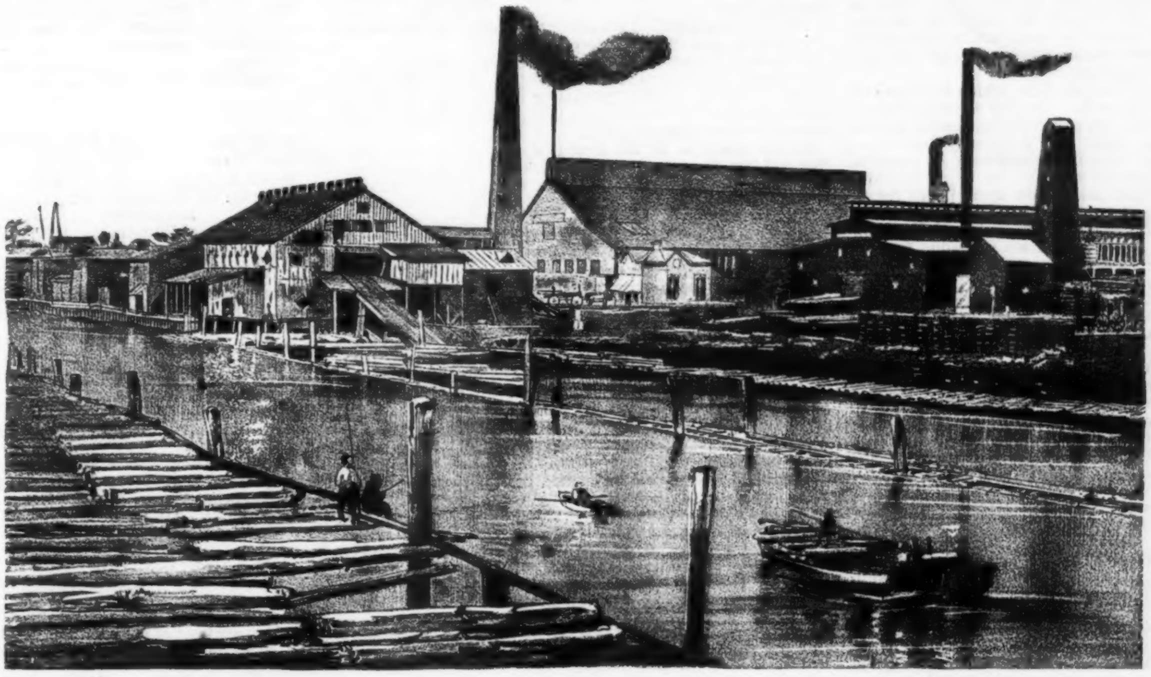
These cisterns or outside settlers were formerly built in size 20 by 30 feet and 6 feet deep, having a capacity of 25,000 gallons. More recently the size of these has been increased to suit the wants of the manufacturer. They are built of sound 2 to 3 inch plank, well and properly keyed together by strong gripes, and are also calked to prevent leakage. These cisterns are elevated on piling or framed timbers, high enough to allow the settled brine to flow through pipes to the blocks.

The connections from the cisterns into the pipes are 6 inches above the bottom, the flow of the brine being controlled by gates. The supply pipes from the cisterns are usually made of wooden pump logs having a 3-inch bore.

The brine, as shown by the analyses, contains a small percentage of carbonate of protoxide of iron, held in solution by an excess of carbonic acid.

If the brine was boiled down or evaporated with this iron in, it would give the salt a red color and very materially affect its commercial value.

As soon as the cistern is filled with brine, preparation should be made to settle it. A tight box large enough to hold a barrel or more of water is placed on the top of the



WORKS OF THE BUFFALO SALT COMPANY, EAST SAGINAW, MICH.

cistern. In this a proper quantity of fresh burnt lime is slacked with fresh water, enough being afterward added to fill the box, so as to make a whitewash or milk of lime. The mixture being a caustic lime, is freely sprinkled over the brine. The brine is then thoroughly "plunged"—that is, it is stirred up until the lime is well mixed with the brine. The caustic mixture of lime having a strong affinity for the carbonic acid extracts the same from the brine, thus releasing the iron which is precipitated with the lime to the bottom of the cistern as an insoluble peroxide of iron. The brine is then allowed to rest for 48 hours, when it is quite clear and ready for the boiling house or block. This process is called "settling," and on the care with which it is conducted depends much of the success in making good salt.

EVAPORATION OF BRINE.

Having made a stock of settled brine, the next process in the manufacture of salt is the evaporation of the brine; and this is effected by three different methods:

1st. By the direct application of fire-heat to kettles and pans.

2d. By the use of steam, either exhaust steam from saw-mills, or steam generated by flue boilers built expressly for the purpose.

3d. By solar evaporation.

EVAPORATION OF BRINE IN KETTLE BLOCKS.

A kettle block for evaporation of brine consists of a wooden building, 140 feet long by 45 to 50 feet wide, with an elevation of 18 feet, so framed as to admit of the steam passing out at the ventilators. In this building are set from fifty to sixty kettles, having each a capacity of 100 to 120 gallons. The kettles are set in two rows over arches running from the mouth or furnace to the chimney. These are called "arches." These arches run close together, with a dividing wall between them; the kettles are set close together in a row, resting on the dividing wall on the one side and on the inside wall on the other.

The fire arch or furnace at the front is 3 feet from the bottom of the kettles; from here the bottom of the arch gradually rises so that under the back kettles the space is only 10 or 12 inches. Here the flue passes into the chimney, which is about 40 to 50 feet high.

Between the arches and the salt bins, which are under the same building, is the sidewalk. On this sidewalk the salt boiler operates in drawing the salt from the kettles into the draining baskets, which, when it is sufficiently drained, are wheeled off to the salt bins on this sidewalk or platform. The bins, which run the entire length of the block, are divided off in sections, and are made with open floors for the proper drainage of the salt.

Through the centre of the block, just on top of the middle wall, two sets of pump logs or pipes are laid—one for fresh water, and one for the settled brine, each of them being supplied with faucets for each kettle.

The kettles, after being well cleansed, are filled with brine, and boiling soon commences after the fire is under good headway. A scum rises to the surface, which is taken off with a skimmer.

Of late years, owing to the dry and light material used for fuel (being the refuse slabs from saw-mills), the first ten or fifteen kettles in the arch are protected from the excessive heat by patent arches, which are built over the fire flue, and directly under the bottom of the kettle. By this arrangement and a narrowing of the flue, the heat is distributed more evenly through the entire arch, and the kettles boil more regularly.

Soon after the brine commences to boil, the crystals of salt commence to form on the top, and then fall to the bottom. When the brine is boiled down to about one-third, the salt is dipped out with a ladle and thrown into a basket, which is placed over one side of the kettle. The salt is allowed to remain in the basket for two or three hours, the bitter water containing the earthy chlorides being thus drained off. Thorough drainage is considered an important point in this mode of manufacture. The balance of the brine or bitter water remaining in the kettle is now bailed out into the drainage trough. The kettle is then rinsed out with fresh water, and again filled up with brine.

The difference of the time in which the front and the back kettles boil down varies from four hours in the front to twelve hours in the back. The kettle blocks are generally run day and night by four men, two boilers and two firemen, taking tours of twelve hours each. The average product of a good kettle block is seventy-five barrels of salt per day of twenty-four hours.

EVAPORATION OF BRINE IN PAN BLOCKS.

Pan blocks are buildings of various dimensions, built to accommodate the size of the pan, settlers, and salt bins.

The pans are made of quarter-inch boiler-plate iron. They vary from 90 to 120 feet in length, being divided into sections of 30 or 40 feet, are 12 to 15 feet wide, and from 10 to 12 inches deep. With some the sides are straight, the salt being raked to the side, lifted out with a shovel, and thrown on the draining boards. In others, the sides are flanged, and the salt is raked directly on to the draining boards.

Pans of the above size rest on three walls as in kettle blocks, the arches running directly under the pan to the chimney at the end. As the firing of these blocks is done mostly with slabs and light fuel, the first 30 or 40 feet are also protected by patent arches thrown across the flues, thus dividing the heat more generally throughout the block.

The brine boils very rapidly in these blocks, and as the salt makes fast, it requires much care and attention on the part of the workmen to keep the salt from baking on the bottom of the pan; this is prevented by raking out the salt almost as fast as it makes.

Improvements in heating pan blocks have been made of late years in those localities where the price of fuel is a consideration. A pan block of an improved plan for boiling the brine has been erected by Messrs. Ayres & Co., of Port Austin, Huron County.

The block is 120 feet long, 43 wide, outside post 10 feet high, the centre post 18 feet high—almost too high to carry off the steam in winter. The length was also calculated for four pans. Three pans only were put on, being each 30 feet long and 16 feet wide on bottom, sides flanging and bolted to the draining boards.

The pans rest on seven walls, which are so arranged that they make two fire flues in the centre and two return flues on the sides.

The centre and outside walls run the entire length and width of the pan. All the walls are a foot wide at the top. The two fire flues which are under the middle of the pan on both sides of the centre wall are 2½ feet wide. Height of grate to pan, 3½ feet. The return flues are next to the outside walls, under the sides of the pan, and are 2 feet wide. This gives a heating surface of 180 feet in length on both sides of the middle wall. The outside flues run into the chimney, which is placed at one side of the front of the block—the space under the pan being reduced to one foot.

The advantage of this arrangement of the flues is that, as the brine boils freely over the fire flues, the salt, as it makes, is thrown to the cool side of the pan, and therefore it is not so liable to bake to the bottom of the pan before it is raked out. Another advantage is in the economy of the heating surface, the entire amount being well used up before it gets to the chimney. This is shown in the amount of salt made—Ayres and Co. reporting the making of 140 barrels of salt with 13 cords of hemlock wood in a day of 24 hours.

The brine for pan blocks is settled cold in the outside cisterns, and in most instances is brought to saturation by the inside steam settlers. The salt, as it makes in the pan, is drawn out by rakes upon the draining boards, where it remains for a time, when it is shovelled into barrows and taken to the store bins for further drainage.

It is very desirable that the draining boards should be so arranged in pan blocks that the workmen should not be compelled to walk over them in the operation of drawing or wheeling off the salt.

EVAPORATION OF BRINE BY STEAM.

The evaporation of salt brine by the steam process is now producing the largest portion of salt made in Michigan.

In describing the arrangements of a steam salt block and the accompanying process, we have selected the steam salt block, drill house, cisterns, and saw mills of the Buffalo Salt Company, managed by Sears & Holland, of East Saginaw, and represented in the accompanying view.

This steam salt block is 140 feet long, 122 feet wide, and has an elevation of 52 feet to the top of the ventilator. Height of ventilator, 16 feet. Included, therefore, in the above space are the inside settlers, grainers, salt bins, and packing room.

The inside steam settlers are 136 feet long, 9 feet wide, and 6 feet deep, made of 4-in. plank, well keyed together, and tightly calked.

This block is supplied with seven grainers, 136 feet long, 7½ feet wide, and 16 inches deep.

Over each drainer are the draining boards running the entire length. Passing through each settler and grainer, and near the bottom, are 4-in. galvanized tubing, four or five in number, depending on the size of the grainer, through which exhaust or live steam is forced.

In the steam as in the kettle process, the brine is first pumped into the outside settlers, where it is partially settled. It is then drawn into the inside steam settlers, where it is heated up by the steam pipes and brought to saturation—that is, a point just preceding the formation of salt crystals. It is allowed to remain until all sediment of iron has fallen to the bottom, by which time it becomes as clear as crystal.

The brine is now ready to be drawn into the grainers, which are filled to about two thirds of their capacity, or nearly full. As the settled brine comes into the grainers quite warm and full saturated, it soon commences to make salt, which forms on the surface of the brine, and then falls to the bottom of the grainers, when a new lot of crystals are formed, to fall in the same way. The brine is also occasionally stirred so as to make the crystals fine. Thus the evaporation continues for twenty-four hours, the temperature being kept at 170° to 175° of Fahrenheit. The brine being sufficiently evaporated by the time, the workmen commence the "lifting." This is done by first washing the salt in the brine that is left in the grainers, and then taking it out with shovels and throwing it on the draining boards, where it remains a number of hours for drainage.

A large "lift" or "draw" fills the boards with salt, and it is a beautiful sight to see the salt as it comes white and sparkling from the brine. The salt should remain on the draining boards to drain thoroughly, twenty-four hours, if possible, before going to the bins. It lies in the bins two weeks to complete the drainage, when it is ready for inspection and barrelling for shipment.

SOLAR EVAPORATION OF BRINE.

The first preparation for solar evaporation is to have a series of covers or wooden vats. The covers are rectangular in shape, being 16 by 18 feet and from 6 to 8 inches deep. They are raised on wooden supports, 2 to 3 feet from the ground, and are arranged in sets or strings. Each cover has a movable roof, which can be run on or off to protect or expose the brine, according to the weather. At the end of the string of graining covers, somewhat higher and deeper, are the "strings" of settling covers into which the brine is led from the store reservoirs or cisterns. No lime is used in settling the brine in this process; for in these deep rooms, the brine absorbs a portion of oxygen from the air, by which means the carbonate of iron, which is dissolved in the recent brine, is converted into an insoluble peroxide of iron. In Syracuse, a second series of covers are used to get rid of the gypsum, which separates or is deposited in the form of a crystal. As the quantity of gypsum is very small in the Saginaw brines, these rooms are now dispensed with.

As soon as there is a show of salt crystals, the first stage of the process is accomplished, and the saturated brine known as salt pickle is ready for the last stage. It is then drawn into the salt room or graining vats, in which the salt soon commences to crystallize on the bottom of the covers.

"One of the conditions required for the production of a good, large-grained solar salt, which is most esteemed in the market, is that the bottom in the covers in the salt room should be as smooth as possible, rough surfaces favoring the deposition of numerous small crystals. It is also necessary to have the salt covers supplied with a sufficient supply of good pickle, so that the salt already deposited may always be covered. An exposure of the salt uncovered to the air favors the formation of new small crystals, and the addition of an unfinished or not sufficiently concentrated pickle produces the same effect. It is also important that the waste or exhausted pickle from which the greater part of the salt has crystallized should be discharged from time to time, as its presence not only impairs the quality, but diminishes the quantity of the salt deposited."

The time required for the evaporation of sufficient pickle to make a crop of salt depends largely upon the weather, dry and clear weather, of course, being most favorable; six weeks to two months is the usual time. Three crops of salt a season are gathered: the first about the middle of July, the second in the early part of September, and the third at the end of October. The second crop is generally the best, as it is coarser than the others.

The crop of solar salt is first gathered by loosening it from the bottom of the "covers" with a rake or spud. It is then washed in the pickle that is still left in the cover, and "gathered" to the street gunwale. Here it is shoveled into draining tubs, to remain a short time before being emptied into the salt carts for removal to the salt bins for further drainage.

TREATMENT OF CRUDE PRODUCT.

The legal time, fourteen days, required for drainage having passed, the bins are opened and the salt is packed in barrels holding five bushels, or 280 lbs.—each barrel being branded with the name of the firm or person manufacturing the same.

GRADES AND QUALITY OF MICHIGAN SALT.

The salt product has been divided by the State Inspector into the following grades;

Fine.—In barrels, 280 lbs., suitable for general use for all family purposes.

Packers.—In barrels, 280 lbs., suitable for packing and bulking meat and fish. One of the best and purest grades of salt, and branded, when coarse, C Packers C.

Solar.—In barrels, 280 lbs.; when screened, branded C Solar C for coarse, and F Solar F for finer grades. Solar salt suitable for bulking meats.

Second Quality.—All salt intended for No. 1 of any of the above grades, when for any cause it is condemned by the Inspector, is branded Second Quality and sold as such. This salt is good for salting stock, hay, hides, etc.

ANALYSIS OF SALT.

Experience proves that the best quality of salt can be made from Michigan brines, and that a great preponderance of the salt sold in the market has been found as pure and as efficient an antiseptic as any mined or manufactured elsewhere, either in our own or foreign countries.

The following are analyses of various grades of Michigan salt:

Kettle Salt made by the East Saginaw Salt Company, East Saginaw, Michigan. Analyzed by Dr. C. A. Goesmann.

Sulphate of lime	0·3165
" calcium	0·3564
Chloride of magnesium	0·1408
Moisture	3·3441
Chloride of sodium (salt)	95·8422
	100·0000

Pan Salt made by Taylor & Co, Zilwaukie. Analyzed by Dr. H. C. Hahn:

Sulphate of lime	0·088
Chloride of calcium	0·737
" magnesium	0·445
" sodium (salt)	98·730
	100·000

Steam Salt made by New York and Michigan Salt Company, at Zilwaukie. Analyzed by Dr. H. C. Hahn:

Sulphate of lime	0·363
Chloride of calcium	0·699
" magnesium	0·313
Moisture	3·308
Chloride of sodium (salt)	95·327
	100·000

Solar Salt made by New York and Michigan Salt Company, at Zilwaukie. Analyzed by Dr. H. C. Hahn:

Sulphate of lime	0·173
Chloride of calcium	0·743
" magnesium	0·417
Moisture	2·197
Chloride of sodium (salt)	96·470
	100·000

Average analysis of common salt, made by Dr. C. A. Goesmann, of Syracuse salt:

Sulphate of lime	1·2550
Chloride of calcium	0·1550
" magnesium	0·1369
Moisture	3·0000
Chloride of sodium (salt)	95·4531
	100·0000

The amount of salt made in Michigan by the different processes for the year 1875, was as follows:

Kettle salt	117,000	bbls.
Pan "	199,100	"
Steam "	741,439	"
Solar "	24,336	"
Total	1,081,865	bbls.

FUEL.

The fuel used in kettle blocks is cord wood, mixed soft and hard, refuse slabs, and sawdust from sawmills. Mixed wood now costs $1.25 per cord, delivered at block. Slabs cost 45 to 50 cents per cord at the mills.

A kettle block will consume 10 cords of mixed wood in 24 hours, or 16 cords of slabs in the same time.

Pan blocks on the Saginaw River are run almost entirely with slabs and sawdust from the sawmills. On the lake shore, mixed cord wood is the fuel used. A pan block 90 feet long and 60 feet wide, as above described, will use 13 cords of mixed wood in 24 hours, making 140 barrels of fine salt.

Steam blocks are mostly heated during the day with the exhaust from the sawmills. This is the steam that has been made in the mill boilers. Having performed the work of running the mill engines, it is then exhausted into the pipes connected with the salt block, which carry it through the settlers and graining pipes, and causes the evaporation of the brine. If the mill does not run at night, the boilers are connected directly with the steam pipes in the salt block, and live steam is used, the fuel being the sawdust left from running the mill in the daytime.

BARRELS, MATERIAL, AND COST.

The salt barrels of Michigan are now mostly made of pine staves and heading. In some localities elm staves and ash heading are used. Most of the pine staves are made of the refuse lumber from the sawmills. The elm stave is mostly made from stave bolts cut for that purpose.

There were manufactured into salt barrels, on the Saginaw River, last year, staves, heading, and hoops as follows:

Staves	16,195,480
Heading	6,138,000
Hoops	9,872,000

The barrels are mostly made by hand in cooper shops connected with the salt blocks. The average cost of salt barrels is from 28 to 30 cents each. The Rules and Regulations on Cooperage are as follows:

COOPERAGE

(*Regulations in Regard to Barrels.*)

All staves must be of such length that when the barrel is finished it shall not be less than 30½ inches, or more than 31½ inches long. Soft-wood staves, whether rove or cut, to be ½ an inch thick. Hard-wood staves 7/16 of an inch thick after seasoning. Staves not more than 4 inches wide, of sound timber, and properly jointed.

Heading must be ⅝ of an inch thick, of good, sound lumber, free from holes or unsound knots, smooth for branding. No basswood will be allowed for either staves or heading.

Hoops to be 1 inch wide and ¼ of an inch thick, 10 to each barrel, shaved and well set.

Barrels for fine salt must have heads 17½ inches in diameter. Chime to be 1 inch from point of croze. Bilge from 21 to 21½ inches in diameter outside.

Solar salt may be packed in barrels not less than 30 inches in length with a head 16½ inches. Barrels charred on the inside must be rejected.

Gould's steam salt block at Carrollton, Saginaw County, Mich.:

Size of block, 177 feet long, 84 feet wide, with an elevation of 26 feet. It has two inside settlers and 5 graining vats.

Size of settlers, 126 feet long, 7½ feet wide and 6 feet deep.

Size of grainers, 126 feet long, 7 feet 9 inches wide, and 15 inches deep.

Outside settlers, 20 x 30 feet, 6 feet deep, 4 in number.

Bin room for storing 3,000 barrels of salt, unpacked. Shed room for 3,500 barrels of packed salt.

Capacity of block, 126 barrels a day, and has 2 salt wells.

Engine and boilers for two wells	$2,800 00
Drilling salt wells	2,200 00
Poles for wells	250 00
Tubing "	1,400 00
Pump chamber and valves	250 00
Salt block, cisterns, settlers, and grainers	9,600 00
Tubing and connection to salt block	3,500 00
Total	$20,000 00

COMPANIES, CAPITAL, AMOUNT OF SALT MADE, NUMBER OF KETTLES, GRAINERS, PANS AND COVERS, DEPTH OF WELLS, ETC.

Salt Works and Location.	Salt made in 1875.	Capital Invested.	No. of Blocks.	No. of Grainers.	No. of Kettles.	No. of Pans.	No. of Covers.	No. of Wells.	Depth of Wells.	Mode of Manufacture.
BAY COUNTY.	bbls.								feet.	
John McGraw & Co., Portsmouth	43,837	$25,000	1	10				3	1000	Steam.
M. Watrous & Son, "	8,475	20,000	1	4				2	1000	"
A. Miller, "	48,812	60,000	2	9				4	2050	"
S. McLean & Son, Bay City	25,135	50,000	3	8				3	2050	"
S. H. Webster, "	15,988	20,000	1	3				1	1040	"
A. Rust & Co., "	27,134	20,000	1			8		2	1000	Steam and Pan.
Hay, Butman & Co., "	New	20,000	1	5				2	1036	Steam.
N. B. Bradley & Co., "	29,294	30,000	2	7				2	1000	"
William Peter, "	27,988	20,000	1	6				1	1047	"
Eddy, Avery & Co., Bay City	35,292	35,000	2	5		8		3	1050	Steam and Pan.
H. M. Bradley & Co., "	21,243	20,000	1	5				2	1000	Steam.
Pitts & Cranage, "	23,292	25,000	1	5				2	960	"
N. W. Gas and Water Pipe Co., Bay City	11,660	20,000	1			2		3	740	Steam and Pan.
Folsom & Arnold, Bay City	10,135	25,000	1	5				2	954	Steam.
Chapin & Barber, "	31,006	20,000	2	5	60			2	938	Steam & Kettles.
Dolson, Chapin & Co., "	26,796	25,000	2	6	68			2	950	" "
John McEwan, "	14,529	20,000	1	4				2	935	Steam.
Atlantic Salt Co., "	21,563	58,000	1		60		404	2	800	Kettles and Solar.
J. P. Hall, "	New	20,000	1	4				1	823	Steam.
Carrier & Co., "	15,329	20,000	1	4				2	735	"
Moore & Smith, Banks	8,791	20,000	1	3				2	830	"
Leng & Bradfield, "	5,351	23,000	1			3		1	800	Pan.
Taylor & Moulthop, "	4,781	25,000	1			2		2	840	Steam and Pan.
Keystone L. & Salt Co., Banks	6,196	20,000	1	3				1	980	Steam.
H. W. Sage & Co., Winona	51,089	40,000	1	20				4	1020	"
W. H. Malone, Salzburg	New	20,000	1	4				1	1023	"
Eadrach Bros., "	8,000	10,000	1		50			1	1000	Kettles.
L. L. Hotchkiss & Co., Salzburg	8,728	20,000	1	5				2	1013	Steam.
SAGINAW CO.										
East Sag. Salt Mf. Co., E. Saginaw	30,208	110,000	3		120		493	3	806	Kettles and Solar.
A. P. Brewer, "	18,960	25,000	1	5				2		Steam.
C. & E. Ten Eyck, "	5,705	15,000	1	3				1		"
Warner & Eastman, "	New	20,000	1	6				1		"
Sears & Holland, "	22,936	75,000	2	7		3		2	750	Steam and Pan.
Thompson & Camp, "	15,240	20,000	1	4				1	750	Steam.
Burnham & Still, "	3,329	15,000	1	3				1	762	"
Gebhart & Estabrook, "	New	20,000	1	5				1	820	"
George Rust & Co., "	21,945	20,000	1	6				2	820	"
Eaton, Potter & Co., "	4,515	20,000	1		60			1	825	Kettles.
Bundy & Youmans, "	12,575	15,000	1		68			1	820	"
H. Beschke, "	New	10,000	1			2		1	828	Pans.
Sturtevant & Green, Saginaw City	21,907	30,000	2	5	68			2	830	Steam & Kettles.
Swift & Lockwood, "	15,848	20,000	2	4	68			2		" "
Barnard & Binder, "	26,367	50,000	2	4		2		3	830	Steam and Pan.
Conrad Kull, "	14,931	10,000	1		60			1	802	Kettles.
Geo. F. Williams & Bro., "	16,168	20,000	1			3		1	800	Pans.
C. T. Brenner, "	5,319	10,000	1	3				2	770	Steam.
Pierson, Wright & Co., "	24,752	25,000	1	5				2	741	"
Chicago Salt Co., Florence	3,300	50,000	2		120			2	800	Kettles.
Shaw & Williams, "	25,609	25,000	1			6		1		Pans.
H. B. Allen, Carrollton	5,621	10,000	1			2		1	800	"
E. F. Gould, "	11,350	20,000	1	5				2	800	Steam.
T. Jerome & Co., "	19,350	25,000	1			2		1	746	Pans.
E. Litchfield, "	Not run	75,000	3		180			1	743	Kettles.
H. Ballentine & Co., Carrollton	"	30,000	1		60			1	763	"
Saginaw Valley Salt Co., "	3,000	20,000	2		120			1	780	"
H. P. Lyon & Co., "	11,941	20,000	2		60		500	2		Kettles and Solar.
A. J. Bliss & Bro., Zilwaukie	17,431	20,000	2	5		2		2	835	Steam and Pans.
John F. Driggs & Co., "	5,153	25,000	2		60	2		1	840	Kettles and Pans.
Rust, Eaton & Co., Zilwaukee	23,432	25,000	2	4	60			1	800	Steam.
New York and Mich. Solar Salt Co., Zilwaukie	13,877	270,000	1	4			2695	3	860	Steam and Solar.
W. R. Burt & Co., Melbourne	49,117	75,000	2	8				4	950	Steam and Pan.
LAKE SHORE.										
Frank Crawford, Caseville, Huron Co.	29,065	30,000	2	3				3	1760	" "
Pigeon River Furnace Co., Caseville	5,206	90,000	1	6				1	1760	Steam.
Ayres & Co., Port Austin	13,994	20,000	1			3		1	1198	Pans.
New River Salt Co., New River	6,964	15,000	1			3		1		"
Port Hope Salt Co., Port Hope	14,884	20,000	1			3		1	785	"
Jenks & Co., Sand Beach	New	20,000	1			3		1	702	"
Thomson & Bro., White Rock	32,414	20,000	1			6		3	565	"
Grant & Son, East Tawas, Iosco Co.	Not run	20,000	1	4				2	905	Steam.
Weeks Bros., " "	8,895	25,000	1	4		1		2	835	"
Loud, Gay & Co., Oscoda	New	50,000	1	8				3	1103	"
Smith, Kelly & Dwight, Oscoda	New	25,000	1	4				1	1070	"
Totals	1,081,865	2,216,000	95	240	1310	55	4092	119		

LABOR.

The work connected with a kettle block can be accomplished by 7 men and 1 two-horse team, divided as follows: 2 boilers, 2 firemen, 1 engineer, 1 salt-packer, and 1 teamster.

The capacity of pan blocks being greater than that of kettle blocks, more labor is required, and is divided as follows: 4 boilers, 3 firemen, 2 engineers, 2 salt-packers, and 2 or 3 teamsters.

Steam blocks being run with exhaust steam, the same firemen who run the mill during the day are employed. At night an extra man is put on. The number of boilers varies with the capacity of the block, being from 4 to 6 men, engineers 2. In many of the steam salt blocks the boilers also pack the salt, after they have finished lifting the same.

In the early history of the salt manufacture the supply of good labor hands was not equal to the demand. Of late years the supply has been largely in excess.

The average price of labor in 1864 was $2 a day. In the present year the average per day for salt laborers is $1.25.

FIXED OUTLAY IN DETAIL.

The following figures give the fixed outlay of E. F. Gould's steam salt block at Carrollton, Saginaw County, Mich.:

The cost of the Buffalo Salt Company's block was $4,000 for tubing and $6,000 for block, cisterns, settlers, and grainers.

PRINTING ON WOOD.

THE Williamsport, Pa., *Gazette & Bulletin* has the following description of the practical working out of a unique idea: A planing mill is a strange place to find a steam power cylinder printing press at work, and yet stranger to find it printing on wood. In the box factory of T. U. Thompson, on Hepburn street, this sight may be witnessed almost any day. The press is similar in principle to the ordinary newspaper cylinder press, and is used for printing the business card of the customer on the boxes—as they are made. It will print a card of about 8x15 inches as clear and distinct on wood as on paper, and is generally used on the ends of small boxes. The rapidity with which it works is not equalled by any ordinary newspaper press. When run at an ordinary speed it is capable of turning out 4,200 impressions per hour, and faster than one man can carry them away. The boards are piled two feet high on the bed and require no feeding. By an ingenious piece of mechanism the lower board is caught by an automatic feeder and forced through the rolls, leaving the pile to settle as it disappears. The type is composed of metal cast into a sheet and moulded to fit the cylinder. It creates a slight indentation in the wood.

NOVEL PATTERNS FOR SLEIGHS.

We have had a long and pleasant correspondence recently with Mr. George Meitinger, the well-known carriage-builder of Munich, Bavaria, who for a number of years edited the *Wagenbau-Zeitung*, the only organ of the carriage trade published in the German language. Mr. Meitinger has kindly sent us the following original designs for sleighs, which from their novelty of general design and unusual grace of outlines, they should prove suggestive to all sleigh-builders, even if these particular patterns are not followed.—*The Hub.*

FIG. I.

FIG. II.

FIG. III.

AN ice machine in Dallas, Texas, just finished, produces ice cakes thirty feet long and six feet wide, weighing from 10,000 to 12,000 pounds each. They are formed by freezing fine rain or spray. When the freezing is done, the bottom and sides of the cake are thawed loose from the inclined plane, and the cake slides out upon a platform where it is cut into pieces six feet square. Four cakes a day are frozen. The works cost $30,000.

REPORTING SPEED.

IN the *Reporter's Guide*, by Thomas Allen Reed, London, we find the following: "No reporter should be content with less than the ability to take a verbatim note of a moderately slow speaker. If he acquires this, and can write with ease and certainty at the rate, say, of 120 words per minute, he will rarely be at a loss with a much more rapid speaker, for if he is unable to secure a strictly verbatim note, he will very nearly attain that result, and by the omission of the less important portions of the speech, will miss very little that the public cares to read, or that the speaker himself would desire to see reproduced."

Mr. Isaac Pitman, in one of his circulars, states that Mr. Reed is the best reporter in the world, and as illustrating the speed of his system, says that Mr. Reed, and one of the Pitmans—Fred., we think—have, on several occasions, written 200 words per minute.

It is reported that the New York *Tribune* sent their best reporter to report Mr. Moody—that he took 2,200 words in 10 minutes, and then had to give it up, as Mr. Moody exceeded this speed.

Mr. George Waring, Jr., of Tyrone, Penn., the editor of *The Phonetic Magazine*, and a first-class reporter withal, replies to this by saying that "the reporters of England all write Pitman's system, and did not find any fault with Mr. Moody's speed."

Is it not probable that one of the above quotations explains this? But Mr. Reed, in another part of the same book, says this:—180 or 200 words in a minute, is no uncommon speed in certain styles of speech, such as the conversational. It may be continued for only a few moments, but the reporter who would reach the highest excellence should be able to seize the most rapid passages, which are sometimes the most effective, and therefore the most worthy of recording.

These two quotations from Mr. Reed's work may not seem very consistent with each other, but as the latter is probably the most worthy of observation, it would be unfair to quote only the one.

Inasmuch as we believe a speed of 120 to be only about half way to 160, and 160 not *over* half way to 200, and as there has been so much said upon the subject and so little arrived at that is definite, we think perhaps a few words upon the subject may be of some use to beginners, who are laboring under the delusion that when they can write 160 words in a minute, they will be accomplished reporters.

In court work, it is seldom we have anything under 140 to 160, and there is seldom a day but we could use a speed of 200 or over to good advantage.

A prominent reporter of this State (Iowa) once said that a reporter who could not sit down and write 200 words in one minute, in any average matter, was *not* a reporter but

an apprentice. We thought at the time that this was cruel, egotistical and decidedly discouraging for a beginner; but we have since learned to believe in him, for there have been many instances when nothing short of this would answer the purpose.

We have seen 6,000 words that were taken in 30 minutes.

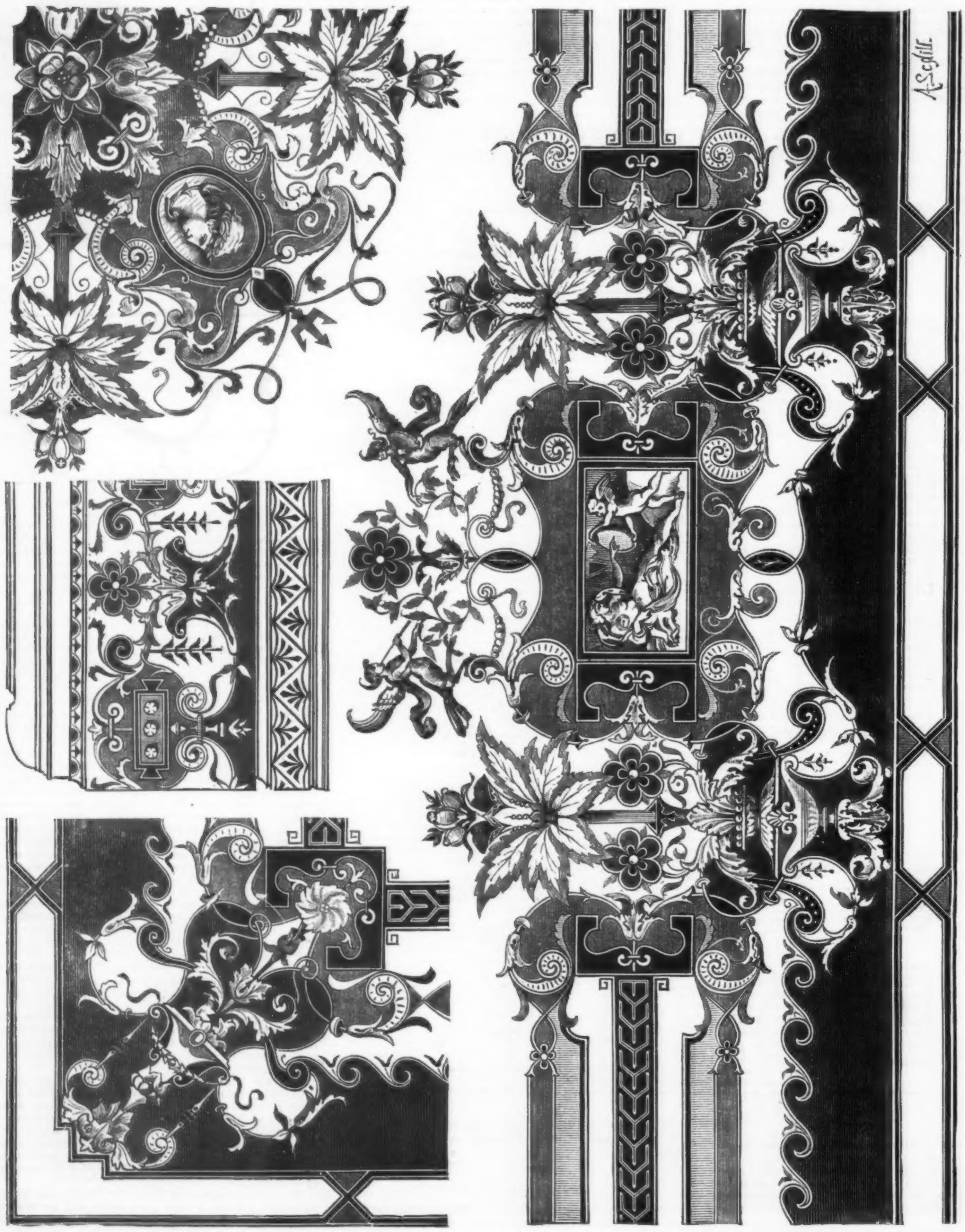
There are several Court reporters in this State who write from 225 to 240 and 250 words per minute, and any of them will admit that there are times when they could use more speed if they had it. Schuyler Colfax is said to average 175

Now, in conclusion, the standard of time must be one minute, for two reasons. First: A speech might average 150 words, and yet range from 100 to 200. Second: No reader can read for any length of time at exactly the same speed; therefore we must conclude—and we are not drawing our conclusions hastily, but basing them upon the opinions and experiences of several of our oldest and best reporters here—that a speed of 175 is absolutely necessary, that a speed of 200 is frequently required, and that if a reporter would be prepared for emergencies, he must be able to write 225 words and even at this speed he will some-

leave phonography where it is? Or should our motto be, the greatest good to the greatest number, an united effort to improve the art.—*Hoyt, in the Canadian Fonografic News.*

DESIGNS FOR FRESCO PAINTING.

INTENDED for the ceiling of a small room. Figs. 1 and 2 show middle and corner ornaments of the ceiling border; Fig. 3 shows a ceiling flower, and Fig. 4 is a design for a frieze below the cornice.



DESIGNS FOR FRESCO PAINTING; BY A. SCHILL, STUTTGART.—*From The Workshop.*

words per minute. He has been reported by three of our reporters here, and their several reports only varied in five or six words.

Judge Swift, of Detroit, averages 200 in his charges. Judge Arnold, of Allegan, Mich., reads his charges at the rate of 200 per minute. It is only a few days since Mr. Ford, of Grand Rapids, who reported him last week, was called upon to read his charge to the jury. What would he have done if unable to write 200 words per minute?

times find witnesses who will walk, talk, right away from him.

And finally, and more than all, that phonography nor short-hand of any kind has yet reached that state of perfection which will enable a writer to defy a speaker. It is within the power of the lowest and meanest witness on the stand to walk away from the nobbiest and best reporter in the land. Perhaps this was not so in Tyro's time, but it is now; and the query is, should the whole world sit still and

Ground color of ceiling light buff, scroll ornaments variegated, forming as in Pompeiian painting, transition between deep colored tints.

The vases in Figs. 1 and 2 with acanthus ornament, and central flower in Fig. 3, are painted in bronze gilt, the pictorial subjects in Fig. 1 and in the medallion Fig. 3 in low relief, the conventionalized foliage and flowers variegated with colored outlines, the ornaments showing throughout flat treatment.

LECTURES ON PARALYSIS AND CONVULSIONS AS EFFECTS OF ORGANIC DISEASE OF THE BRAIN.

Delivered at the Bellevue Hospital Medical College, N. Y., 1877.

By C. E. BROWN-SEQUARD, M. D., ETC.

LECTURE II.

GENTLEMEN:—In the last lecture, as you will remember, I went into general facts and spoke a good many things that are out of the course I intended to follow. Although I have taken up some time in bringing them forward, I must return to them to-day, as there are facts and views that I shall have to mention, which, for their comprehension, require a knowledge of the information I have now to impart. The theories that are now generally admitted as regards the production of paralysis and convulsions, I consider absolutely wrong from beginning to end. Now, as I have taken away the old opinions, I shall, on the other hand, have to present views in order to replace them, and this will require that I must ask a great deal of attention on your part, as they imply a full comprehension of a good many facts which are very difficult of explanation, and a good many theories, some of which are already explained, while others will need much demonstration. I shall endeavor to do my best to make these things clear, in a measure if not completely.

The first point, then, is this: That the old theories as regards the action of the will in the production of movements, are extremely obscure; and I can not understand how it is that they have been admitted for an instant by many others as well as by myself. Since the year 1861, when I first began to advance my new views in lectures, I have met many able practitioners and accomplished teachers, who have told me that they have every moment met with facts that were difficult, or even impossible of explanation by the old views. They, however, did not attempt to understand them completely, or to advance new explanations, but let them pass, thinking that perhaps sooner or later some facts might be discovered that would explain them. Now, as soon as there is a single fact which is in direct opposition to a theory, that theory should be at once put aside, or, at least, considered very doubtful. I think we all of us err greatly in continuing to accept for a long time what should be set aside at once, when it is proved to be inconsistent with facts. Democrats as we are, liberal in some matters as we are, we are often unwilling to move in right direction, but too apt to be conservative in matters where we ought to change.

There are facts which overthrow even the very elements of the old theories, and show them *a priori* to be wrong. We know that slight pressure exerted on the brain can not be a sufficient cause for paralysis. In a great many cases immense pressure does not produce the least paralysis, while in others, a great many phenomena may be caused by an apparently slight pressure. How can these things be reconciled?

Within a few years, facts have been brought forward to show that there are distinct centers in the brain presiding over certain muscular movements. The experiments performed to prove these ideas consist in galvanizing certain parts of the brain, when movements were excited. Now, is it a proof that these movements depend upon putting into activity the will power presiding over them? Certainly not. By tickling the foot certain movements may be produced in the face, but who believes that the center of will for these movements lies in the sole of the foot? The reasoning in one case is equally as good as that in the other, and so we might bring many more analogous instances. Take a case of intestinal worms. There is irritation, and many forms of convulsions and nervous phenomena take place, but are we to conclude from this that the center of will for these movements lies in the muscular membrane of the bowels? It would be just as rational to draw this inference as it is for Ferrier, Fritsch and Hitzig, and others to draw the conclusions which they have done from their experiments, as regards these facts.

Now, let us analyze for a moment the views of Charcot. He published some cases in which, by the destruction of one or two convolutions of the brain, paralysis or convulsions was produced in certain definite parts. These views would be subject to the same criticism as I made a moment ago.

Now, there are many other facts which are serious obstacles in the way of these conclusions. Looking at the brain, on its lateral aspect, we have the fissure of Rolando coming downward from the median line above towards the front. In the front of it lies the ascending frontal convolution. This, according to the theory of those who attempt to localize the centers of will, is the center of movement for the arm of the opposite side of the body. The convolution behind this, the ascending parietal, is, in a measure, a part of that same center. In the neighborhood of the median line and a little posterior is a center said to be that of movement of the leg. Now, Charcot himself published, in a French journal, with a number of admirable woodcuts, a case in which destruction of the whole of this latter portion produced paralysis of the arm instead of the leg, and consequently this would show that the center of movement for the arm was located farther backward than in other cases. In another place we find the report of a case in which there was disease of this region with destruction only of that portion in which was situated the center for the arm, but there was paralysis of both arm and leg of the opposite side. Everything behind the fissure of Rolando was destroyed, and in such a case we ought to have paralysis of the leg but not of the arm; but there was complete hemiplegia.

Now, if you look upon a great many cases of destruction of the convolutions, you will find that a great deal of tissue may be destroyed without paralysis or convulsions occurring. Now, on the other hand, destruction of a very limited portion of brain tissue will often produce paralysis of the arm or leg, but the location of destruction is not fixed. In reality, all the facts are clear that these conclusions are absolutely wrong.

But it is not only there that the theory that one half of the brain serves to supply the other half of the body fails. If you follow the fibres from the surface you find many crossing from one side of the brain to the other, from the right to the left side, and *vice versa*. By irritating the brain we sometimes get convulsions on the same side, and sometimes on the opposite, conveyed by irritation. This ground is well established by Charcot himself. If a degeneration of nerve fibres takes place on one side, it is propagated downwards across the medulla oblongata to the other side of the cord, out to the nerves, and even to the muscles. This seems the most plausible explanation. If there is a disease of the convolutions it is propagated from the brain to the nerves, and it seems clear that we have to deal with degeneration following down the course of the nerve fibres. This is probably what takes place in all cases of motor trouble. If you study the circumstances in which such cases appear, and the details of all the facts concerning them, you will find many reasons to sustain the conclusions I have drawn from them.

Professors Charcot and Vulpian, of Paris, and Westphal, of Berlin, all have found cases in which disease of the convolutions was followed by a degeneration of fibres. There is an influence exerted on the nutrition of the fibres at the base of the brain, and on the nerves of the opposite side, without direct propagation of the original morbid process. There are fibres going in a continuous channel from the convolutions to the nerves. We must therefore admit that a lesion in the surface of the brain can produce a change of nutrition at a distance. We see this plainly exemplified in the production of tetanus. An injury to a nerve in the sole of the foot, or any other portion of the body, produces a change in nutrition of the spinal cord, without a direct transmission of the lesion along the nerve.

We may find more reasons still against the old views. Where there is disease of the right side of the brain, secondary changes may occur in the whole of the anterior pyramids. At first sight this may seem in harmony with the old view, but the fibres of the anterior pyramids pass through in such a way to the spinal columns, that most of the fibres are in the lateral columns instead of the anterior columns as they ought to be. Now, where does the secondary degeneration occur? Only in a small part of the lateral columns, and that in the posterior portion; there, only, the secondary degeneration exists. Now, we all of us know very well that this posterior part of the lateral column does not contain any voluntary motor fibres. Here, then, we are evidently out of the track. If the theories were right, those parts that should be affected would be the anterior portions. There is, therefore, in this study of the secondary changes a great point in disharmony with the old theories.

Now, there are still further decisive reasons relative to the action of the surface of the brain. If we apply any other than galvanic stimulus or irritation to the cerebral surface, we will never find the least trace of movements. I instituted a series of experiments and tried by all the other known methods, such as the various mechanical, chemical, and cutting irritants, but failed to produce the least trace of movements such as those described. Burning the surface of the convolutions produces facts of the most interesting nature. If we cauterize with a red or white hot iron the surface of the brain on one side, we find occurring a most important fact relative to the symptoms shown in brain disease. In one instance especially such observations were noted. The animal was a dog whose brain had been laid bare, and the surface of the middle lobe cauterized. When the animal came from under the influence of the anaesthetic, whose effects had lasted but a few moments, he exhibited some very curious phenomena. My friend, Professor Hyam, who has made special and exhaustive studies on meningo-spinal inflammations, and who was present during the experiment, was of the opinion, after considering the symptoms, that there was inflammation of both the spinal cord and its meninges. I have seen other dogs under the same conditions show the same phenomena. An autopsy showed that there was no inflammation, and I knew that it was not likely that such a condition existed, but even if it were so, it would prove that irritation of the brain could propuce a change of nutrition at a distance. But another thing took place, although the dog had all the symptoms that are ordinarily evidences of inflammation of the cord and its meninges. He had extreme stiffness of the posterior extremities, turned over on his side, with contraction of the muscles, and extreme sensibility of the skin. At times he had jerks and convulsive movements. Now, in this case, what takes place is what we see in many cases of brain disease. The jerkings and convulsive movements occur without inflammation. There is some peculiar condition of the cells produced. Here is a convulsive disorder brought on with great rapidity in a healthy animal. It can not be an inflammation, as the rapidity is too great, and it could not in any degree be due to the anæsthesia, as the power of feeling and the consciousness of the animal were completely restored in a very short space of time. It is a change in the nutrition and vital action of the cells in the spinal cord, and especially in the lumbar enlargement. It occurs from the irritation in the surface of the brain.

There is an immense power produced by irritation, and this may be readily conceived when you reflect that the surface of the brain is placed in connection with every organ of the body, so that it may have its circulation or nutrition altered. The brain produces symptoms through an irritation caused by disease or injury to any part of its tissue, starting at the particular part involved and going to a distance either in the brain or spinal cord, and producing variety in its effects according to the nature of the cells attacked by the irritation. Aphasia, anæsthesia, and any other loss of the various functions of the brain is produced in the same way. All of those cases in which a function is lost, in the brain itself or any other organ of the body, depend on an irritation starting from one place and acting on the other part, and not on the destruction of a center.

Suppose you have a case of disease encroaching on one of the origins of the optic nerves. You know that they are special nerves in this, that they have a union of fibres in the middle of their course forming what is known as the optic chiasm. According to the theory of Dr. Wollaston, of London, the optic band is composed of two parts, one going to one eye and one to the other. The corresponding halves of each eye are supplied by fibres from the same side. If the left optic band should be diseased, there would be hemiopia or loss of sight on one side of each eye, on the external side of one eye and the internal side of the other. This is what the theory would predict, and does occur in some cases. But continuing to review what ought to take place we find that if the disease exists only in a small part of the left side of the band, we ought to find that then only one half of one eye will be affected. There are such cases. If it is the other part that is affected then it is only one half of the other which should be affected. There are also facts of that kind. So that there are three kinds of facts which seem to support the theory. But, on the other hand, there are clear cases against it. There are a great many facts which show that a disease in one half of the brain will produce complete loss of sight of the two halves of one eye, either on the same side, or on the opposite side, or the two halves of both eyes. Therefore, there are three series of facts, and one only would be enough, which demonstrate that the theory ought to be rejected. One half of the brain is quite sufficient for use in the production of sight.

I know that, in certain of these cases, as my former assistant Dr. Hughlings Jackson has chiefly contributed to establish, there can be an alteration of nutrition produced by contiguity, and the amaurosis in such a case is secondary. There may be a neuritis of the retina, but loss of sight sometimes occurs without neuritis being present. The most conclusive evidence, however, is that, in seven cases of disease of the optic chiasm with entire destruction of the brain tissue in the neighborhood, there was no amaurosis at all. These facts certainly give the death blow to the theory that one side of the brain serves one half of the body, and the other, the remaining side. One half of the brain is amply sufficient for both sides. How is it that there is amaurosis without an optic neuritis? The answer is simple and applies to every other nervous structure besides the optic band. Disease of the optic band, as well as the tissue of the brain or any other nervous tissue, can produce just what galvanism of the par vagum produces on the heart. You all know very well that by galvanizing this nerve you can produce complete arrest of the activity of the heart. This is a passive action, if we may use the term, and if you cease with the galvanization, the action of the organ may be restored. A phenomenon of this kind explains everything that produces a loss of function in every part beyond the origin of the nerve implicated. Those parts that do not contain the nerve cells produce the loss of function, not because the tissue is destroyed, but because an irritation is started.

But you will say, how is it that there is such a variety of effects produced in the eye? The answer is evident if you follow the phenomena produced by the irritation of certain nerves. For example, if you follow the irritation produced by worms in the intestines, you may get hemiopia and other affections of the eye; paralysis of one limb, or of two limbs, of the face, or tongue, or in fact of any part of the body. If there is such a vast variety of effects produced when the nerve fibres irritated are at a distance, why is the brain not able to act within itself as well as elsewhere? If we tie the hilus of the supra-renal capsule of an animal, and thus irritate the vessels and nerves, we will stop the heart's action and the animal will soon die, always within nine days, while if we take away a much more important organ, as the kidney, it may live very much longer.

All causes in which there is loss of function, as deafness, loss of vision, loss of action of the muscles, loss of memory, of mental activity, of speech, etc., must be explained by admitting that it is not due to disease in a particular locality, but to an irritation transmitted from one place to another. The parts are endowed with the power of propagating an irritation from place to place. Suppose a disease exists in the cerebellum, producing amaurosis; nobody has dreamt of locating the sense of sight in that organ. There are such cases, where the sight is lost in one or both eyes, on the same, or on the opposite side to the disease. An action at a distance undoubtedly takes place. Experiments performed on animals confirm these results. In some cases sight is lost by division of the restiform bodies. In most cases the results are produced by irritation at a distance exciting a restraining or inhibiting effect. There are some objections to be made here, but I will keep them for another lecture, where they will be more in place.

Now as regards convulsions. Convulsions are supposed to appear from a mechanism different from that which produces paralysis. Convulsions do not always come on only where there is a disease on the surface of the brain, over the supposed centers of motion, for we can produce convulsions by irritating parts that do not contain motor centers. Convulsions and paralysis both may appear, no matter in what part either the irritation or disease. Take, for instance, disease in the optic thalami, which have nothing to do with voluntary movements. This function is commonly supposed to depend upon the corpus striatum, or on certain centers in the neighboring convolutions and fibres springing from them which pass through the corpus striatum. Now, facts prove that disease of the optic thalamus far more frequently produces convulsions than disease of the other lobes, much oftener than disease in the corpus striatum or other motor ganglia. In comparing these facts we have clear evidence that there is no connection between the power of producing voluntary movements and convulsions. Still there is this evident in the case of the pons varolii, or meso-cephalon as it is called by some. Robert Bentley Todd, and then after him Nothnagel, believed that it was the center for epileptic movements. This portion of the brain has certainly a peculiar power under galvanism. It is the only one that produces clonic movements, all other portions produce tonic contractions. These clonic movements are what occur in convulsions. The tonic movements resemble those of voluntary motion. In a dog, in tonic contraction, you see the fore or hind leg raised or pushed out and held in that position, while excitation of the pons varolii produces clonic contractions in which the limb is shaken and jerked about. To conclude from that fact that in that particular spot is located the center of epilepsy, I cannot at all understand. The fact is that convulsions have so little to do with it, that they rarely occur when the pons varolii is diseased. Of eight or ten places in which tumors may be seated and produce epileptic convulsions, the disease is least often found in this one. There is a place in front of it, irritation of which has produced convulsions on one side, but disease has produced convulsions on the wrong side according to the theory. There is no rational ground whatever to conclude, because convulsions have occurred, the existence of a center relative to epilepsy and convulsions. Now, if we are to draw such conclusions, there is a place on the base of the brain, which, when irritated, produces phenomena of even a more singular character. This part when irritated produces rotary or circular movements. The man or animal who has this point irritated or diseased will keep up a continual rotation of the body, either going round in a circle or rotating on the long axis of the body. This very thing occurred to a very eminent scientific man in London. He was suffering from some trouble with the ear, and had nitrate of silver injected into that organ. A short time afterwards he commenced to turn round and round in bed without cessation. Such movements are frequently produced by a mere prick in the brain. Now, if we are to conclude that a circus movement or a quick rotary movement depends on irritation of a certain center; that where a lesion is made to produce a movement, in that place is the center, we would have to locate many of these centers in a great many places. In man as well as in animals these movements are sometimes produced, but not in all cases; so are we to conclude that the center exists in one man and not in another? We must believe that chorea, epilepsy, catalepsy, etc., depend on the propagation of an irritation to certain cells at a distance which produce the movements. As I said before, these movements are of two kinds, the loss, or production, of an activity. The

types I have taken, paralysis and convulsions, occur in a loss of function or a putting into activity those that were at rest. But there is a common element to the two forms. In both cases an irritation starts from the place of the disease. The difference begins in the distant part, and the character of the result depends upon the kind of cell implicated, whether there is loss of function, or an increase or morbid change of normal action.

I pass now to the other part of my subject, and shall begin to enter upon details elucidating certain facts. Let us first place our attention on the anterior lobes of the brain. One half of these lobes may frequently be destroyed by disease without the manifestation or appearance of paralysis. Now there are portions more posterior that have been considered as being connected with the memory, by that most eminent man Carpenter, among others, who grounds his views on experiments which show that the posterior lobes have no action when galvanized, and on the fact that they are more developed in man than in animals, and are developed in proportion to the intelligence. They are, therefore, looked upon as the seat of intellectual activity. The facts relative to the anterior lobes are different. The posterior lobes are certainly the most indifferent parts of the brain. Large as they are they seem to be less endowed with function, or at least with those functions we know of. There are functions that we do not know of, or are unconscious of, and as we must suppose that if a function exists there must be an organ to perform it, it may be that the posterior lobes are the seat of this power.

But to come back to what I was trying to establish. These lobes may be destroyed without causing any difference in the action of the rest of the brain. If we commence destroying the brain little by little we shall have to destroy a large portion before the activities described by Fritsch and Hitzig will be abrogated. The old experiments of Flourens, consisting of removal of the hemispheres, show that all the activities can go on. This has led me to admit that the real organization of nerve cells and fibres is not such as to correspond with the necessity of the existence of particular centers. The real organization is this: The cells which are employed in performing certain functions, as for instance, the power of expressing ideas by language, are not situated in one spot, but are scattered all over the brain, so that a great destruction of tissue can take place without the loss of the function. The whole of the third left frontal convolution, including the insula of Riel, that has been regarded as the seat of the power enabling us to express ideas in speech, may be destroyed without loss of this function. There is, therefore, the absolute necessity to admit that the function is more generally diffused, and belongs to more parts than this particular locality. This is a hypothesis which is in perfect harmony with all the facts of which we have any knowledge. It may at some future time be overthrown, but at present it is sufficient to explain all phenomena that occur.

The function of moving the right side of the body belongs to cells that are scattered on both sides of the brain, and one side may be sufficient to call into activity both sides of the body. Such is likewise the case with every other function of the brain. As regards the anterior lobes, we know that they can be carried away without important results, if they only contain a portion of the cells necessary to voluntary movements. In point of fact, both the anterior lobes have been entirely destroyed and no symptoms of paralysis resulted. We cannot, therefore, place these faculties where they have been located. The same thing holds true with regard to the power of expressing ideas by language, of moving the arm, and certain muscles of the face. If we go back further, to the middle lobes, we find that they can be destroyed without loss of power. If we take what relates to various other portions of the brain, as regards the power of producing convulsions we find the same facts to be true.

I have collected 187 cases of epilepsy due to tumors, and I am glad to say they were not my own cases but those of others, well described. In three cases only was the disease due to pressure on the corpora striata. These portions have, as I need not tell you again, been considered centers of motion. There were due to pressure on the corpus callosum two cases, anterior lobes ten, optic thalami fifteen, posterior lobes nine, and various other portions, the remainder, 148. This shows an immense variety of places in which the disease can be produced.

In most cases in which the membranes of the brain are diseased, you have convulsions, and there you have another argument against there being disease of the centers. This much as regards the meninges. In cases of hemorrhage, in 170 cases, in 37 there were convulsions, while they only appeared 19 times in 43 cases of tumors of both corpora striata and optic thalami in 158 cases.

If we take again an examination of various parts of the brain we find corroborative evidence. In the base, convulsions or paralysis come on very rarely from disease of the parts just above the ventricles, if only the white tissue be diseased. Disease in the crura cerebri produces convulsions rarely, but paralysis frequently. This fact likewise militates strongly against the old theories. In six or seven cases where the crura cerebri were diseased, there was no appearance at all of paralysis or convulsions. In one case paralysis occurred on the same side as the disease in the crus.

IRON AND ITS CONSTITUENTS IN REGARD TO PHARMACEUTIC PREPARATIONS.

By HENRY G. DEBRUNNER, Chemist.

IT may be deemed excusable for a Pittsburgher to entertain a very high opinion of iron, and if a Pittsburgh chemist particularly dwells on this subject it can hardly be taken amiss. When we consider that this element is one of the chief constituents of the earth's solid crust, varying in quantities from two to ten per cent. in the primary rocks, besides its general presence throughout the animal and vegetable kingdoms, a closer examination of its character will be justifiable. The manifold useful applications of iron in the arts and manufactures, its occurrence in numerous ores and minerals, in the green pigment of plants and the red one of blood; its presence even in the sun and the distant fixed stars, where it has been detected by aid of the spectroscope, render it an article of universal interest.

When making ferruginous preparations, which are used in considerable quantities on account of their great therapeutic value, it is the aim of the pharmacist to procure the purest iron in the market. Chemically pure iron (Fe) is not an ordinary commercial article. The finest Pittsburgh tool steel, which fully equals, if not surpasses, the best of Sheffield make, contains, besides combined carbon, 0·05 per cent. of silicon, 0·008 per cent. of phosphorus, 0·006 per cent. of sulphur, 0·1 to 0·2 per cent. of manganese, and minute traces of various other elements, while cast iron contains from 88 to 97 per cent. of pure Fe and a high percentage of manganese.

THE KINDS OF IRON USEFUL IN PHARMACY.

The Pharmacopœia recommends iron wire as material for iron preparations; musical wire, being steel and therefore purer, is also often applied and will yield sufficiently pure preparations. Their analyses are as follows:

	Iron wire.	Musical (steel) wire.
Carbon	0·2730 per cent.	0·5320 per cent.
Silicon	0·1418	0·0700
Phosphorus	0·0809	0·0427
Sulphur	0·0610	0·0182
Manganese	0·7027	0·0600
Copper, trace		
Iron (Fe)	98·7406	99·2771
	100·0000	100·000

(Quantity taken for analysis, 20 grams.)

The material I would recommend is soft steel drillings, they being cheaper, purer and not so difficult to dissolve as wire, which by the different mechanical processes of forging, hammering, rolling and final drawing has become denser and harder. The more impure an iron the quicker it will dissolve, but the same piece of iron or steel will more rapidly dissolve the less it has undergone the above-mentioned mechanical treatments. If we consider the immense amount of mechanical labor to which an iron or steel bar is subjected until its diameter is reduced to that of wire, it is evident that soft steel drillings, shavings or turnings deserve preference. Axles and steel boiler plate, of which turnings and drilling can easily be obtained at any steel work or machine shop, rank among the purest brands of iron, in the chemical sense of the word. Their composition is shown by the following analysis:

	Axle.	Boiler plate.
Carbon, combined	0·2700 per cent.	0·3010 per cent.
Silicon	0·0800	0·0492
Phosphorus	0·0382	0·0298
Sulphur	0·0157	0·0163
Manganese	0·0747	0·0643
Iron (Fe)	99·5124	99·5394
	100·0000	100·0000

(Quantity taken for analysis, 20 grams.)

It may be considered a practical rule that any brand of steel that will make good axle or boiler plate will also yield pure preparations on dissolving.

ACTION OF DIFFERENT ACIDS ON IRON.

Let us examine, now, what becomes of the different constitutents of iron on dissolving it in different acids.

If iron is acted on by hydrochloric acid the following reaction will take place: $Fe+2HCl=FeCl_2H_2+$. Combined carbon is chiefly carried off in the form of a hydrocarbon, while the entire graphitic portion is left in the black insoluble residue. Iron phosphide is similarly decomposed, particularly on heating the solution, forming phosphoretted hydrogen. Silicon partially may undergo the same reaction, the larger quantity of this element, however, will be found in the black carbonaceous residue. Sulphur, if not combined with copper and arsenic, will be entirely eliminated as gaseous combinations, while manganese and iron remain in solution as chlorides. If copper is present among the impurities of iron, it will combine with the sulphur, forming copper sulphide, which will be found in the insoluble residue. Silicic acid from slag particles, pre-existing in the material used, may be detected in minute quantities, on oxidation and evaporation of the resulting solution to dryness, etc. If steel has been used, slag particles are absent. It is evident that from a pure iron these impurities are of no significance; when, however, pig iron or other impure brands are used, they may cause precipitates in a concentrated solution. Drillings of soft steel, containing 99 per cent. of iron (Fe), combine at the same time convenient shape with the highest practical purity. I have often had samples which dissolved perfectly in dilute hydrochloric acid without the application of heat. The product of this reaction is an aqueous solution of ferrous chloride, Fe_2Cl_4, which is filtered, and finally converted into ferric chloride, Fe_2Cl_6, by the addition of the necessary quantities of hydrochloric and nitric acids, when the following exchange of molecules will take place: $Fe_2Cl_4+2HCl+2HNO_3=Fe_2Cl_6+2No_2+2H_2O$.

The action of sulphuric acid on iron is similar to the foregoing, most of the impurities being carried off as gaseous combinations, while the graphitic carbon is left as a black insoluble residue, together with some silicon. Highly concentrated sulphuric acid hardly acts on iron in the cold; but on heating, sulphurous anhydrid, SO_2, is formed, while the dilute acid rapidly dissolves it to ferrous sulphate, liberating hydrogen.

The behavior of iron to nitric acid is essentially dependent on the concentration of the latter. Highly concentrated aqua fortis converts iron into its passive state, thus preventing any further reaction. When in this peculiar modification it will neither be acted on by weaker acid, unless touched with another clean piece of metallic iron, when liquefaction and evolution of gas will begin at once. Medium strong acid, of about 1·25 specific gravity, forms ferric nitrate, $Fe_2N_6O_{18}$, on evolution of nitric oxide, NO, which, in contact with atmospheric air, is oxydized to hypo-nitric anhydrid, N_2O_4, forming red fumes. Very dilute nitric acid, finally, when acting on iron in the cold, transforms it into ferrous nitrate, $Fe(NO_3)_2$ forming at the same time ammonic nitrate by the action of nascent hydrogen on nitric oxide, NO, in presence of nitric acid. The latter gas (NO), if absorbed by the ferrous solution, produces a black coloration of the same. The formation of ammonic nitrate takes place in accordance with the following equation:

$$\underset{\text{Nitric oxide.}}{NO} + \underset{\text{Hydrogen.}}{5H} + \underset{\text{Nitric acid.}}{HNO_3} = \underset{\text{Water.}}{H_2O} + \underset{\text{Ammonic nitrate.}}{NH_4NO_3}$$

The lower the temperature during this process, the larger the quantity of ammonic nitrate formed. The different chemical processes which take place when iron is acted on by very dilute nitric acid are illustrated by the following scheme of equations:

$$a.\quad \underset{\text{Iron.}}{Fe} + \underset{\text{Nitric acid.}}{2HNO_3} = \underset{\text{Ferrous nitrate.}}{Fe(NO_3)_2} + \underset{\text{Hydrogen.}}{H_2}$$

$$b.\quad \underset{\text{Iron.}}{Fe} + \underset{\text{Nitric acid.}}{8HNO_3} = \underset{\text{Ferrous nitrate.}}{3Fe(NO_3)_2} + \underset{\text{Water.}}{4H_2O} + \underset{\text{Nitric oxide.}}{H_2}$$

These two reactions take place at the same time and are followed by the formation of ammonic nitrate above alluded to. On adding five times the equation *a* to *b*, in the presence of an excess of $2HNO_3$, we obtain

$$\underset{\text{Iron.}}{8Fe} + \underset{\text{Nitric acid.}}{20HNO_3} = \underset{\text{Ferrous nitrate.}}{8Fe(NO_3)_2} + \underset{\text{Water.}}{6H_2O} + \underset{\text{Ammonic nitrate.}}{2NH_4NO_3}$$

thus expressing the different chemical reactions in one equation.

The nature of the reddish-brown flocculent body which is formed from the combined carbon is not yet sufficiently investigated. Its ability of producing lighter and darker colorations of the ferric solution, proportionately to its quantity, forms the basis of Eggertz's colorimetric method for its estimation in steel. The results agree to 0·02 per cent. with those obtained by combustion analysis.

On dissolving iron by means of iodine, the total quantity of carbon remains in the residue, the resulting solution containing but the iodides of the metallic elements, viz.: ferrous and manganous iodide, the latter in minute quantity. An excess of iodine, however, will also oxidize the non-metallic impurities, as phosphorus, sulphur, etc., by decomposing water and with the formation of hydriodic acid, HI. For the preparation of pure ferric iodide, Fe_2I_6, it is therefore essential to filter the solution of the green ferrous salt, Fe_2I_4, before adding a further quantity of iodine. As to the carbonaceous residue, it may be stated that it contains chemically combined iodine, and was found by Eggertz to have the following composition, when dried at 212° F.

Carbon, C	59·69 per cent.
Water, H_2O	22·50
Iodine, I	16·00

leaving, on ignition, some siliceous ash.

CURIOUS FACTS ABOUT TEMPERING.

It is really interesting to observe what an important influence carbon exerts upon the metal iron, the commercial brands of which should be, scientifically, called carburets of iron. "Spiegeleisen," a white crystallized and highly manganiferous cast iron, which is used in large quantities in the Bessemer process, corresponds to the formula Fe_4C_c; it contains its total carbon (about 5 per cent.) in combined condition. In gray pig, the larger portion of this element exists in the graphitic modification, sometimes approximately corresponding to the formula $Fe_4C_c + C_{gr}$. Among the numerous interesting phenomena which these combinations exhibit, I cannot help to mention one which, although being very frequently observed, still lacks a sufficient explanation of its causes. I refer to the process of hardening steel, as practised daily by every blacksmith. If a piece of steel at red heat is dipped into cold water an entire change of its structure takes place; its grain becomes finer and denser its tensile strength almost double to what it was before, while its hardness nearly reaches that of diamond. Acids will hardly attack it in this state, no edge tool will produce an impression on the bar, which, before being subjected to this simple treatment, easily could be drilled or filed. These facts become still more interesting if we know that at the same time the volume of the bar has become larger and its specific gravity decreased. Salt water or mercury will produce a still higher degree of hardness and a larger expansion of the hardened bar, while a soap solution has no hardening effect on steel. None of these phenomena will take place in iron free from carbon, while hardness and tensile strength will proportionately increase with the latter, reaching their "practical maximum" at 1·2 per cent. combined C. This can by no means be called a mere physical change, but seems to be the result of a chemical reaction between the iron and its other constitutents. I have previously mentioned that on dissolving iron in hydrochloric acid the combined carbon is carried off as carburetted hydrogen. If, for instance, the gases that form, on treatment of "Spiegeleisen" with the above acid, are allowed to pass through alcohol or concentrated sulphuric acid, part of them will be absorbed, and may be separated again, on dilution with water, in the form of an oily liquid which is colorless, possesses a strong, rather disagreeable smell, and consists chiefly of the hydrocarbons of the ethylen series, $C_n H_{2n}$. Besides these combinations, the characteristic group $C_{10} H_{16}$ of the volatile oils has also been found to be an admixture of the hydrogen gas liberated in this process. Resinous bodies, very probably products of decomposition of the foregoing compounds, are found in the carbonaceous or siliceous residue on dissolving, and may be extracted by ether or caustic alkalies. Sulphur and phosphorus also give rise to the formation of organic compounds containing these elements.

That the investigation of inorganic bodies may sometimes yield results allowing conclusions on the most complicated organic and physiological processes may be fairly illustrated by the following instance: As many physiologists admit the carbon, isolated from carbonic acid by the green parts of plants, under the influence of solar light, to be able, in its nascent state, to unite with water, forming a carbohydrate, it would be a strong support of this theory if a carbo-hydrate could be formed synthetically in the indicated manner and at a low temperature. That this primordial hydrate may form the basis of the numerous other compounds, elaborated by plants on ulterior transformation, is far easier to believe than the above hypothesis, without any experimental support. P. Schützenberger and A. Bourgois first expressed this idea in their "Researches on the Carbon in White Cast Iron," and succeeded in forming a compound, to which they gave the formula $C_{22}3H_2O$. It can be constantly obtained by treating spiegeleisen, Fe_4C, with a cold solution of cupric chloride, when the following reaction will take place: $Fe_4C+4CuCl_2=4FeCl_2+C+Cu_4$. The carbonaceous residue of copper is then treated with cold ferric chloride, to which some hydrochloric acid has been added. Copper will rapidly dissolve, leaving a brownish-black but little bulky residue, which, dried at 212° F., corresponds to the above-mentioned formula, $C_{22}H_6O_3=C_{22}3H_2O$.

DIALYSED IRON.—FERRUM DIALYSATUM.

May I be allowed to conclude this paper with a few remarks on ferrum dialysatum and its analysis? The demand for this new preparation, which doubtless will take the place of most of the other ferruginous compounds, chiefly on account of its almost entirely tastelessness, is continually increasing. A sample, which I prepared according to one of the methods lately published in this journal, gave on analysis:

Ferric oxide, Fe_2O_3	4·02	4·71 per cent.
Ferric chloride, Fe_2Cl_6	0·60	
Water, H_2G	95.29	
	100·00	

(Chlorine = 0·45 per cent. combined with 0·24 per cent. iron to form 0·69 per cent. Fe_2Cl_6.)

It possessed all the characteristic properties of the commercial article, leaving on evaporation in the water bath 5·08 per cent. hydrated ferric oxychloride. The approximate chemical formula derived from the above analysis lets it appear as an aqueous solution of $Fe_2Cl_6+12Fe_2O_3$ or $Fe_{26}O_{36}Cl_6$. In order to obtain a very basic oxychloride I consider it necessary to keep the solution to be dialysed, during precipitation, or addition of the separately precipitated and washed ferric oxyhydrate, at as low a temperature as possible. Heating in an open vessel, as well as in hermetically sealed glass tubes, under pressure, will produce a precipitate insoluble on subsequent dialysis.

In order to test the percentage strength of dialysed iron, without evaporating a weighed quantity to dryness or determining ferric oxide and chlorine by weight or volumetric analysis, I would propose the following colorimetric method, which will give quite satisfactory results, particularly if applied to products that have been prepared by exactly the same process. Having obtained a clear, tasteless, dark-red solution, which will not precipitate on addition of silver nitrate,* it is removed from the dialyser, and compared with a standard solution of known strength, which has been determined by careful weight analysis. The modus operandi is as follows:

a. The standard solution consists of 10 cc. of dialysed iron (5 per cent.), diluted with distilled water of 60° F. to the volume of 200 cc. Twenty cc. of this solution are then introduced into a true cylindrical tube of 50 to 60 cc. capacity, graduated into 0·1 cc. In order to make the

B. Calorimetric comparison, 2 cc. of the solution to be tested are put into a similar tube of exactly the same dimensions, and diluted with distilled water until its shade is exactly the same as that of the standard. To produce a perfect mixture, the tube is shaken after every addition of water. If the standard solution has been prepared from dialysed iron, leaving exactly 5 cc. of residue on evaporation on the water bath, every cc. of the diluted solution of the sample to be compared will correspond to ¼ per cent. of residue of the original sample, and its volume expressed in cc., when of equal shade with the standard, divided by four, will give the percentage strength desired.

I have compared results of this colorimetric method with those of weight and volumetric analysis, and find it correct to 0·05 per cent. In the following I will give a few examples to illustrate the method proposed:

Standard: $\frac{20 \text{ cc.}}{4} = 5$ per cent. residue.

1. Sample compared was to be diluted to 18 cc. to equal shade of standard. $\frac{18 \text{ cc.}}{4} = 4\frac{1}{2}$ per cent. residue.

2. Sample compared was to be diluted to 23 cc. to equal shade of standard. $\frac{23 \text{ cc.}}{4} = 5\frac{3}{4}$ per cent. residue.

From these data, we easily can calculate to what volume any quantity of dialysed iron is to be evaporated or diluted to obtain the desired strength of 5 per cent.† As a mode of analysis only requires a few moments time, being at the same time sufficiently correct for practical purposes, it may be preferable to that of evaporation.

Black Diamond Steel Works, Pittsburgh, Oct. 6, 1877.

* On addition of silver nitrate I have observed dichroism of said solution. It appears turbid in the reflected, but perfectly clear in transparent light.

† As to the necessary glass tubes I would recommend the same as used in the laboratories of steel works for colorimetric carbon determinations, viz.: Two true cylindrical tubes, closed at one end; capacity 50 to 60 cc., graduated into 0·1 cc., internal diameter about three-eighths of an inch; both exactly of the same dimensions and of best white glass.

ON CHRONIC MALARIAL POISONING.

A CLINICAL LECTURE RECENTLY DELIVERED AT THE UNIVERSITY MEDICAL COLLEGE, NEW YORK

By ALFRED L. LOOMIS, M. D.,

Professor of Pathology and Practice of Medicine.

THIS patient, who states that he is 35 years old, says he has been sick since last April; that at that time, after an unusual exposure to wet and cold, he was taken suddenly with a severe pain in the right side, which compelled him to go to bed. He had a hacking cough with little or no expectoration; he was confined to his bed about two weeks before he expectorated anything after coughing, and then the sputa consisted of a "grayish slime." He was unable to leave his house for about six weeks. Since that time he has not felt well. Though his cough has not troubled him, and he has not lost much flesh, nevertheless he has felt weak and unable to work, being fatigued after slight exertion.

The first question that arises in connection with this history is, What was the nature of this attack? Pain coming on suddenly in one side always leads one to pleurisy. It is true that in pneumonia we have pain in the affected side, but not until the pleura becomes involved. In bronchitis, patients will have pain in the chest, but the pain is located behind the sternum. When pain in the chest is severe, and localized on one side, if you exclude chronic affections, such as intercostal neuralgia, pleurodynia, aneurism, and the like, you are led to pleurisy as its cause; without physical examination of the chest you will be unable to remove the doubt. We will, therefore, submit the chest of this patient to a physical examination before proceeding with his history. On inspection we do not notice much, except a slight shrinking on the right side. We perceive that the right clavicle is a little more prominent than the left. The chest, however, expands well and evenly on both sides. You notice that the right shoulder is a little lower than the left, but this is a very common occurrence, and usually depends on slight lateral curvature of the spine. Both scapulæ move well, and there is not much difference between the motion on the two sides. Now the free movement of the scapulæ, the absence of retraction on either side, and a free expansion of the chest on both sides, lead us to conclude that there is no extensive disease of the lungs or pleuræ. We can assert this from inspection alone. On palpation, we find the vocal fremitus to be feeble, but this may be due to the naturally high pitch of the patient's voice. The tones are not very sonorous, and this fact would account for the alteration from the ordinary fremitus. On comparing the two sides, we do not find any difference. On percussion, we find very fair resonance, both anteriorly and posteriorly, and little or no difference between the two sides. On auscultation the vesicular murmur is heard all over the chest, though, perhaps, it is not quite as intense in the right infra-scapular region as in the left. There is a slight pleuritic friction sound also present in the right infra-scapular region. Now the question comes, Is it possible to have a pleuritic friction sound after so long a time has elapsed since the primary attack of pleurisy? This question must be answered in the affirmative, as we may often hear a pleuritic friction sound a year or more after the primary attack. The vesicular breathing is less intense on the right side, because there is probably some thickening of the pleura, and this thickening interferes with the free expansion of the pulmonary tissue in the vicinity. Except these two minor points, the physical examination is entirely negative.

Our physical examination of the chest, therefore, excludes any active or progressive disease of the lungs. Still this man is sick and unable to work. His pulse is weak, and, on counting, is found to vary from 120 to 130. Let us proceed, then, to a further investigation of his case.

On percussion over the liver, we find it to be of normal size. Over the spleen we find a considerably increased area of dullness. When we press firmly down over the abnormal area of dullness, we feel a solid mass much below the normal bounary of the spleen, and it gives the patient pain when we press firmly on it. This leads us to the conclusion that he has an enlarged and tender spleen.

The enlarged spleen starts us, then, in another direction, and we must go back and enter more fully into his history from another starting-point. He tells us that he lives on Long Island, near Flushing, and has lived there for nearly fourteen or fifteen years. This district, I need not tell you, is one of the worst in the vicinity of New York for the development of malarial diseases. The patient says he had a severe and prolonged attack of chills and fever three years ago, but has had no regular malarial paroxysms since.

We must conclude, I think, that the enlargement of the spleen is due to malarial infection; and a condition of chronic malarial infection would be ample cause for his weakness, inability to work, and disturbed circulation. As you notice, his surface is pale, and his face has somewhat of a yellowish hue. I think, then, we can now easily sum up his case: We have here a man suffering from a chronic malarial infection, a very common condition, and one which gives rise to a series of symptoms which cannot be enumerated or tabulated, so numerous and so various are they, and appearing under so many different forms. We may have neuralgias of various forms, that may or may not be periodical in their occurrence. We may have various dyspeptic symptoms, that cannot be relieved by the ordinary dyspeptic remedies; various forms of headache, that are often treated as grave forms of cerebral disease. In some there is confusion of mind, a staggering gait, loss of power in some portion of the body—the mental faculties may become impaired; I have known the subjects of chronic malarial poisoning, in the middle of an argument or speech, to suddenly lose the thread of their discourse, and go on talking for half an hour perfectly unconscious of what they were saying. Other persons are affected with a sort of inertia, which renders it impossible for them to do work of any kind. They are not sick enough to go to bed, but too ill and habitually tired to perform anything requiring the least exertion. Some, again, get short of breath, have a rapid, weak, irregular pulse, pass sleepless nights; and so I might go on for an hour, and still be unable to detail to you all the symptoms that chronic malarial infection may give rise to.

In all cases of chronic malarial infection we have important changes in the constitution of the blood. It contains free pigment, becomes thin, deficient in red globules, and no longer retains its normal, nutritive power. In consequence of this the whole system is affected, and we get secondary changes in all the organs, always, however, attended by primary enlargement of the spleen. In order that a person should become thus infected, it is not necessary that he should have distinct intermittent paroxysms. It is quite sufficient that he resides for a long time in a malarial district, as he is constantly exposed to the poison. If this patient were to move away from where he is at present living, to a place free from the malarial emanations, he probably would have two or three severe malarial paroxysms, after which it is far more amenable to treatment than now. Quinine or arsenic will not relieve him unless he can remove from the malarial district in which he now resides. Place him in a non-malarious locality, and then quinine will have its controlling power over the disease. Large doses of quinine will do more harm than good, so long as this patient remains in a malarious district. If the disease progresses without even temporary relief being obtained, splenic enlargement will increase, the liver will become involved, and finally general dropsy will terminate the case. The change of residence in this patient's case must be immediate.

This case, gentlemen, is very instructive, for it shows how we are sometimes compelled to arrive at a diagnosis by exclusion.—*Hospital Gazette.*

NERVOUSNESS.

THE number of people in the world who regard themselves as "nervous," in some form, is very large. A perfectly impassive, emotionless man or woman is a rarity; still, such do exist, and we hardly know whether to regard them as objects of envy or pity. Those without emotion, those who do not suffer at times from over-sensitiveness or excitement, are like rocks or trees; the winds of adversity may blow, a deluge of affliction may cover them; they remain calm and happy, the sleep is sound, the appetite unimpaired. Such are certainly enviable conditions, but the law of compensation is not annulled for the benefit of these favored ones.

Wherever we find them, we may be sure that we meet those devoid of the finer and more delicate instincts of human nature: those who are incapable of enjoying the beautiful things in the natural world or in art. They suffer less in the journey of life, but they also enjov less. Like animated statues they live, without strong friendships or affections, without pity, without generosity; and nevertheless they die, with scarcely a pang. The world regards them with suspicion during life, and refuses to weep when they pass away. It is for wise reasons that but few of this class are permitted to make their advent into the world.

Since so large a proportion of the race is "nervous," it may be interesting to inquire briefly into the nature of nervousness, and the different degrees and peculiarities under which it exists.

The nerves, so called, are but prolongations of the brain matter which fills the cavity of the skull, and it is supposed that somehow the mind or soul is blended with or wrapped up in this peculiar form of matter; so that when from any cause it becomes abnormal, the soul or the sensations suffer and also become abnormal; as no two souls or sets of sensations are alike, so no two systems of nerves act alike. If everybody was in perfect health, there would be far less nervous suffering in the world, but still there would be sensitive nerves to trouble not a few. The duality of man all must admit; the soul is one thing, the body quite another. Every possible variety of spirits or souls animates every possible variety of physical bodies, and it is probable that the body is designed to fit or to be adapted to the peculiarities of individual souls. If a human organization were in a normal condition, the pervading essence or soul would work out its destiny, whatever that might be, in perfect harmony. It is not necessary to suppose that there would be perfect happiness or satisfaction in life in every individual instance, but the end for which individual life was created would be met. A great poet or painter has a vital constitution entirely different from that of a common laborer, and his nerves are influenced by causes and objects which make no impression upon the latter. His life is usually one of suffering; for great thoughts and capabilities both of the ideal and beautiful only come through pain. The body may be healthy, but the acute, sensitive, impressible nervous organization is itself the source of suffering manifested through the body. It is also capable of higher felicities and enjoyments, and these come through the physical organism.

A perfectly healthy body is usually tenanted by a healthy mind, but it may be coarse, wayward, mischievous, and may lead the body into such abnormal conditions as to shatter or destroy it. A healthy, well-poised mind in an unsound body cannot long sustain its normal state; it cannot perform its functions unimpeded, or without friction, and "nervousness" results. This means the machine is out of gear, and derangement of motion are the result. It may show itself in sleeplessness, or high excitability, or excessive fear, or strange apprehensions, or some form of monomania, or downright insanity. A naturally healthy mind cannot act normally in a weakened or diseased body any more than steam can move without jar or creak an imperfect or worn-out engine. The steam back of the engine is elastic and strong; knock away or destroy the imperfect machinery, and the perfect propelling force remains ready for any service that awaits it. It is of the highest importance, as we have stated in a former article, that the mind should be trained to take good care of the body, and thus prevent nervous derangements, which so torment us by morbid wakefulness or strange hallucinations.

Congenital weaknesses give rise to much nervous suffering. Many are born into the world with defective physical organizations, but with noble spirits; such are greatly to be pitied, but their cases are by no means hopeless. There are tens of thousands of most useful men and women who are heroically engaged in daily warfare with themselves. It is the tenant defending himself against the creaking, tottering, almost roofless house in which he lives. The nervous ones, made so by physical defects, contrive to secure a considerable amount of happiness, and largely to influence the world for good. This is accomplished by a will power which in a measure dominates over bodily imperfections. This power can be cultivated and strengthened, and every nervous sufferer should strive to gain it, and never yield to despair. Fight out your destiny, rise superior to your weaknesses; this is the text from which sermons cannot be too often preached.

A nervous person exists in the world under great disadvantages. It is like being compelled to play a perfect tune with an imperfect instrument, or to row a boat against wind and tide. Life is fitful, capricious, and every step uncertain. One may be progressing pretty fairly to-day, but to-morrow the nervous currents are reversed, and thick darkness rests upon everything. This is applicable only to the intense forms of nervousness, such as are often met with. There is hope for even these: not that congenital infirmities, affecting the mind, can be wholly restored—that is not to be expected—but by clearly comprehending the situation, exercising the will power, and the best possible care of the imperfect body, life may be rendered in a large measure comfortable and useful.—*Boston Journal of Chemistry.*

THE HYGIENE OF THE HAIR.

PROFESSOR ERASMUS WILSON, who is probably the highest living authority on the subject, has lately given a course of lectures on the hair before the College of Surgeons in London. The following is an abstract:

Cleanliness is insisted upon as of prime importance, but washing the hair is emphatically condemned. Brushing is to be preferred, as it promotes circulation, removes scurf, and is in all respects a more effective stimulant than water. Cutting does not encourage growth as much as is commonly believed, but is advantageous in the case of the short, slender hairs generally called "young hairs."

CURES FOR BALDNESS.

Of the countless applications recommended for the cure of baldness few are ever successful, and in the occasional instances in which they appear to be useful it is possible that sequence is mistaken for consequence, the *post hoc* for the *propter hoc*. Most of these specifics are stimulants, not excepting petroleum, which has lately been eulogized. Croton oil, though excellent as a stimulus, is objectionable on account of the irritation it often causes and which sometimes extends to the eyelids and the face. Cantharides, though milder and more manageable, is likewise liable to give rise to inflammatory congestion and vesication, and sometimes to suppuration and ulceration. The skin may be peculiarly sensitive, or the remedy may have been employed too energetically, both as to quantity and time. Professor Wilson has seen several instances in which cantharidine has been absorbed into the system and has given rise to ischuria. As a rule, therefore, he rarely uses cantharides, and then always in a guarded manner. Certainly, it is not to be trusted to the acknowledged indiscretion of the public as a popular remedy. Acetic acid, or rather strong pyroligneous acid, he has discontinued for many years; but it is still a favorite, notwithstanding its strong and disagreeable odor.

Ammonia is Professor Wilson's favorite stimulant; it is unlikely to create inflammation and its consequences; it is neither absorbable into the system, nor could it do harm if such were the case; and its odor, refreshing at the moment of its use, speedily evaporates. In a case of ordinary madesia or falling out of the hair, he prescribes a lotion composed of strong liquor ammoniæ, almond oil, and chloroform, of each one part, diluted with five parts of alcohol or spirits of rosemary, and made fragrant by the addition of a drachm of the essential oil of lemons. The lotion should be dabbed upon the skin of the head after thorough friction with the hair-brush. It may be diluted if necessary; it may be applied sparingly or abundantly; and it may be used daily or other wise.

There are cases in which a less stimulating and even a refrigerating lotion may be desired, and where an objection

may be raised to the quantity of oil contained in the above. In such cases a lotion of borax and glycerine, two drachms of each to eight ounces of distilled water, is cooling and refreshing: this lotion allays dryness of the skin, removes scurf and subdues irritability.

In cases of complete baldness and also in alopecia areata, a stronger stimulant application will be required. For this he recommends frictions with a liniment composed of equal parts of the liniments of camphor, ammonia, chloroform, and aconite, to be well rubbed into the bare places daily, or even twice a day, so as to produce a moderate amount of stimulation. In cases of ophiasis due to neuralgia of the cutaneous nerves of the scalp, this liniment is very valuable. In other cases the liniment of iodine may be painted on the bare patches daily, or they may be rubbed with the ointment of cantharides or any other powerful stimulant. The intention of all these local remedies is to stimulate without setting up irritation, to increase the energy of circulation and innervation of the part: and in some instances to abstract the excess of fluids from the tissues of the skin by inducing exudation. But these results must be accomplished as far as possible without pain and without severity.

The constitutional treatment of alopecia should consist in the adjustment and regulation of the functions of digestion and assimilation and, where no other special conditions are to be fulfilled, the adoption of a tonic regimen and the administration of tonic remedies. Of these last arsenic bears the palm and may be advantageously prescribed in doses of two to four minims three times a day directly after food, and in any convenient vehicle.

GRAY HAIR.

Grayness, canities, or poliothrix depends like baldness on defective powers of the skin, and the indications for treatment are exactly the same—to strengthen the part and at the same time strengthen the patient. As means of temporarily staining the hair the lecturer mentioned a weak solution of permanganate of potash, a lotion holding in suspension sulphur and acetate of lead, or the so-called *eau des fées*, consisting of the hyposulphites of lead and soda; among dyes sulphides of various metals, especially silver, the pyrogallate of iron and ferro-cyanide of copper. The hair, as is well known, contains sulphur, and a solution of lead brought into contact with sulphur produces a sulphide of lead which is black in color. Sulphur and acetate of lead in suspension and solution in water supply both the elements necessary for artificial coloration of the hair, and constitute the popular lotions sold so largely.

DYEING OF THE HAIR.

Actual dyeing of the hair is a more elaborate process: the hair must be washed with soap in the first place, to get rid of grease, which would otherwise interfere with the absorption of the fluid by the hairy tissues; secondly, the hair being dried, the metallic solution is to be employed and left to soak into the hair; and thirdly, the mordant fluid is to be brushed upon the part with a view to bring it in contact with every individual hair. If this operation sufficed for a considerable period, all would be well, but as the hair grows quickly, the newly-grown part exhibits its original whiteness, and another dyeing soon becomes necessary. The tone of color produced by the first application may have been perfect, leaving nothing to be desired, but the white roots of the hair cannot be reached without a fresh coloring over the whole, and then the evils become apparent. A succession of coats of color renders the hair more intensely black than nature herself could have accomplished, and the harmony of the features of the individual is disturbed; the mellowing of the lineaments of the countenance produced by white hair is reversed by the depth of the blackness, and the features are rendered harsh and severe. The theory that an appearance of youth is maintained by the color of the hair is not consistent with fact, and there is always the danger that the hair may appear youthful, while the features themselves are expressive of old age.

IMPROVED TELEGRAPH INSULATORS.

Although the production of an efficient form of insulators for aerial wires is a most interesting and important problem, the advance made in this branch of practical telegraphy has by no means been as great as could be wished.

The employment of a liquid repellent of moisture placed in a recess formed around the ordinary cup form of insulator was, we believe, attempted some years ago; but either through the imperfect way in which the experiment was made, or in consequence of the utility of a very high state of insulation, not being so apparent as it is at the present day, when economy of battery power and the employment of the duplex and quadruplex systems of working are points of great importance, the idea was not carried into practice. Messrs. Johnson and Phillips, who have paid considerable attention to the production of an efficient form of insulator on the above principle, have so far succeeded as to obtain patterns which have proved efficient under conditions which would be fatal to those of the ordinary form.

Although these insulators require the test of continued use under conditions that exist in ordinary aerial telegraph lines, yet the success that has been obtained is so remarkable as to deserve notice.

Fig. 1, 2 and 3 show forms of these insulators.

Fig. 1. This insulator is fixed above its arm or support in the manner. The lower edge of the porcelain A is turned up inward so as to form a chamber, shown at s, in which oil or some other insulating fluid is placed.

Fig. 2. In this insulator the porcelain consists of two parts, A, the head, is firmly cemented to the bolt P, which passes freely through the second part B, containing the insulating fluid s. B is held in position by the nut N; when this nut is unscrewed B may be lowered so as to expose the oil chamber s to view for the purpose of examination or for the introduction of the oil.

In both cases the insulators are easily filled with the oil or other insulating fluid by means of a long-necked syringe.

Fig. 3 shows how an ordinary porcelain insulator may have the insulating fluid principle applied to it. The cup-shaped space s is partly filled with the fluid. C is a dished metal cover resting upon the porcelain tube T. This cover is not fixed, but is free to rotate round the bolt P; a fan F, attached to this cover, causes it to rotate from time to time by the action of the wind, the object being to break any spiders' webs or filaments which might cause a leakage from the surface of the insulator to the cover. An india-rubber ring W prevents the rain from entering the oil chamber by means of the hole in the cover through which the bolt passes; it also, when properly placed, prevents the cover C from being tilted up by the wind and touching the porcelain. This form of insulator is especially adapted to districts infested with spiders or other web-spinning insects.

The following tests taken on twenty of the patent insulators and on four ordinary white porcelain insulators with a porcelain tube round each bolt speak for themselves.

The loss obtained on the four ordinary insulators is multiplied by five, to make it comparable with the twenty patent insulators, which are assumed to represent a mile of line.

The tests were taken with eighty cells, and an astatic mirror galvanometer.

The absolutely uniform insulation shewn for the patent

Fig. 1.

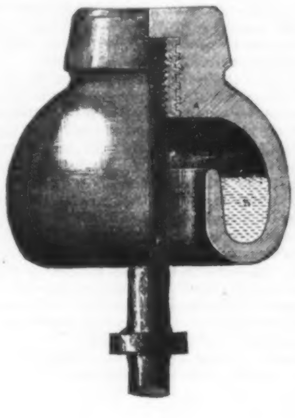


Fig. 2.

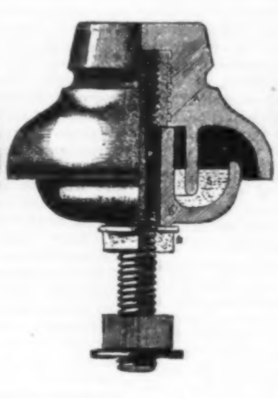
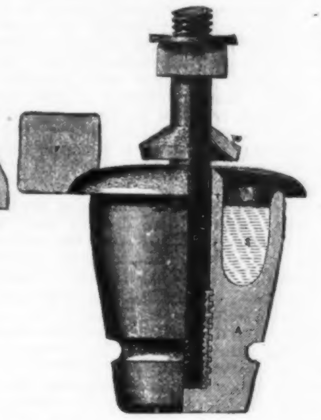


Fig. 3.



insulators is not strictly correct, but the deflection obtained on them never being more than two divisions, it was impossible to detect small alterations in the insulation.

Date.		Resistance in Megohms per mile. (20 insulators) Patent.	Ordinary.	Remarks.
January	25,	—	—	Insulators fixed.
"	31,	about 14,200	254·	Fine morning.
February	1,	"	2·62	Fine rain; raining nearly all night.
"	3,	"	31·18	Bright morning.
"	5,	"	16·85	Fine; frosty.
"	6,	"	9·67	Dull; overcast; has rained in night.
"	7,	"	17·71	Dull; overcast.
"	9.	"	7·21	Fine, but damp, with dew.
"	10,	"	8·74	Overcast; windy.
"	12,	"	23·38	Dull; overcast.
"	"	"	1·10	Shower of rain.
"	13,	"	16·04	Dull; overcast.
"	15,	"	9·33	Dull; overcast; damp.
"	16,	"	38·10	Overcast.
"	17,	"	48·98	Fine.
"	19,	"	5·72	Raining yesterday, and during night; now fine.
"	24,	"	3·62	Dull; overcast; has been raining.
"	26,	"	·71	Rain and hail; strong wind; insulation rose to 83 megohms shortly after rain ceased.
"	28,	"	1437	Fine; bright; sharp frost.

The above figures show the great effect which surface leakage has upon the insulation of an ordinary line; the test taken on February the 12th was very marked, when the insulation of the ordinary insulators fell from 23 megohms to 1·1 megohm in a few minutes after the rain commenced. On the 26th it was equally instructive to notice how the insulation rose, when the rain and hail ceased, and the strong wind blowing at the time dried the surface of the insulators; the change in this case also took place in a few minutes.

The rain on the 26th had cleaned the surface of the insulators, hence the high insulation obtained during the sharp frost on the 28th.

The tests were taken at about 7 A. M.

While all these changes were taking place in the ordinary insulators, it will be noticed that the high insulation, given by the patent insulators, remained perfectly constant (as far as could be detected).

It should be noted that under the influence of frost the insulation still remained good, although it might have been expected that the coagulation of the oil would have prevented such a favorable result being obtained.—*Telegraph Journal.*

The Western and Brazilian Telegraph Company (Limited) announce the restoration of their cable between Bahia and Rio de Janeiro, and also of the Transandine Companies' lines between Buenos Ayres and Valparaiso.

45th Congress, 1st Session. S. 300.

In the Senate of the United States, November 14, 1877.

Mr. Wadleigh asked and, by unanimous consent, obtained leave to bring in the following bill, which was read twice and referred to the Committee on Patents.

A BILL TO AMEND THE STATUTES IN RELATION TO PATENTS, AND FOR OTHER PURPOSES.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That from and after the passage of this act no profits or damages in any suit at law or in equity for the infringement of a patent shall be recovered which shall have accrued more than four years next preceding the commencement of such suit: *Provided,* That where a party, in order to preserve his right of recovery, finds it necessary to institute a number of suits involving the same issues, and he is proceeding with good faith and with reasonable diligence to bring one of them to final judgment, any court in which any of them are pending may, in its discretion, grant a stay of proceedings from time to time in any such other cases pending before it: *Provided also,* That rights of action existing at the passage of this act may be enforced by suits brought within four years thereafter, if not previously barred by laws already existing; but nothing in this section contained shall revive any right of action already barred, nor prolong the right to sue on any cause of action already existing.

Sec. 2. In all cases where the patentee has elected to license other persons generally to use his invention, in like manner to that in which it was used by the defendant, or where it appears to the court or jury that, from the nature of the invention, it is for the interest of the patentee that other persons generally should use the same in like manner and pay him a license fee therefor, the measure of the plaintiff's damages shall be the same, both at law and in equity and no account of profits or savings will be allowed. If a license fee has already been established by a reasonable number of transactions of a character applicable to the case at bar, that shall be adopted as the measure of said damages; but if not, then the court or jury shall determine the same from all the evidence in the case. In taking an account of profits in any case, the defendant shall not be charged with any saving he may have made, unless it has enabled him to realize an actual profit in that part of his business connected with the use of the invention. And the court shall determine what proportion of such profit is due to the use of said invention, and what proportion to the other elements from which such profit was derived, capital and personal services excepted; and the proportion of actual profit so found to be derived from the use of the invention shall be the measure of the profits to be recovered. But if, in any case, it shall appear to the court that the damages or profits, ascertained as above, shall be inadequate to give the plaintiff a just compensation for the injury done by the infringement, or shall be in excess of such injury, the court shall have power to increase or diminish the amount to such an extent as may be just and reasonable: *Provided,* That the provisions of this section shall not apply in any case in which a decree for an account or assessment of damages has at the date of the passage of this act, already been pronounced. Nothing contained in this section shall affect the right of the plaintiff to an injunction.

Sec. 3. In all patent causes, after a decree has been made upon the merits of the case, in favor of the complainant, establishing the validity of a patent, finding an infringement thereof by the defendant, and ordering an account or an assessment of damages, the court in which the cause is pending may, if it shall see fit, authorize the defendant to appeal forthwith from such decree; and thereupon, if such an appeal shall be taken and perfected within such time as the court shall prescribe, it shall be competent for the court to stay proceedings in whole or in part during the pendency of such appeal, and to require from the defendant a bond, with sureties, to answer the final decree in the cause, or to dispense with such bond, as it shall see fit.

Sec. 4. The several courts vested with jurisdiction of cases arising under the patent laws may, at any time during the pendency of any patent cause, grant or suspend the issuing or operation of an injunction upon such terms as the court may impose, and shall have like power after an appeal of said cause, and while the same is pending in the Supreme Court.

Sec. 5. Section forty-nine hundred and sixteen of the Revised Statutes is hereby amended so as to read as follows: Whenever any patent is inoperative or invalid, by reason of a defective or insufficient specification, or by reason of the patentee claiming as his own invention or discovery more or less than he had a right to claim as new, if the error has arisen by inadvertence, accident, or mistake, and without fraudulent or deceptive intention, the Commissioner shall, on the surrender of such patent and the payment of the duty required by law, cause a new patent for the same invention, shown in the model or drawings, or described in the original specification or its amendments, and to which he would have been entitled, and in accordance with the corrected specification, to be issued to the patentee, or in the case of his death or of an assignment of the whole or any undivided part of the original patent, then to his executors, administrators, or assigns, for the unexpired part of the term of the original patent. Such surrender shall take effect upon the issue of the amended patent. The Commissioner may, in his discretion, cause several patents to be issued for distinct and separate parts of the things so shown or described, upon demand of the applicant, and upon payment of the required fee for a reissue for each of such reissued letters patent. The specifications and claim in every such case shall be subject to revision and restriction in the same manner as original applications are. Every patent so reissued, together with the corrected specification, shall have the same effect and operation in law, on the trial of all actions thereafter arising, as if the same had been originally filed in such corrected form, except as otherwise provided in this act. In any suit at law or in equity upon a patent hereafter reissued, the defendant having given notice or pleaded the same in the manner set forth in the forty-nine hundred and twentieth section of the Revised Statutes, may prove in defense to the whole patent, or any of the claims thereof, that the new patent, or any claim thereof, is not for the same invention shown in the model or drawings, or described in the original specification or its amendments, and to which he would have been entitled.

Sec. 6. No machine or other article made prior to the surrender of a patent, and the issue thereupon of a new patent, which, or the use of which, did not infringe such sur-

rendered patent, shall be held to be an infringement of any of the claims of the new patent not existing when such machine or other article was made. All rights of action accruing to a patentee, his executors, administrators, or assigns, for profits and damages on account of any infringement of a patent, prior to its surrender for a reissue, shall remain unaffected by such surrender, and no suit shall be barred or abated by such surrender; and all suits at law or in equity may be maintained for the recovery of such damages or profits in the same manner as if said surrendered patent had expired by its own limitation: *Provided*, That nothing contained in this section shall apply to letters patent reissued prior to the date of the passage of this act.

SEC. 7. Whenever a patent has been issued to one person for an invention actually made by him jointly with another or others, or a patent has been issued to several persons for an invention made by only one or more of them, and such error has arisen through inadvertence, accident, or mistake the Commissioner, upon the application and oath of the true inventor or inventors, and with the written consent of all the owners of said patent, entered of record, may correct the mistake as a clerical error. No new patent shall be issued in such case, but the correction shall be entered upon the old patent, or the record thereof, or both, and said patent shall thereafter, for all purposes, be regarded as having been properly issued, in its corrected form, at the date of its original issue. Upon such correction, a fee of twenty dollars shall be paid, under such regulations as the Commissioner of Patents may, from time to time, prescribe.

SEC. 8. Any person who may wish to perpetuate testimony to be used in any patent suit then pending, or which may thereafter be brought, may do so, subject to the following rules and conditions: He may file a bill or petition in the circuit court of any district in which the parties having a right to sue for infringement of said patent, or against whom he shall desire to use testimony to be taken hereunder, any of them, reside or may be found, setting forth the date, number, and subject of the patent, and the name of the patentee, the names and residences of the several parties interested in said patent, so far as known to him, the names of witnesses proposed to be examined, and his desire to perpetuate testimony, as aforesaid.

On the said parties being brought into court in the usual way, the court may enter into an order or orders in the case, directing when and where, either within or without the district, the evidence shall be taken. Both parties may attend at the time and place or times and places so designated by the court, or at such times and places as they may agree, and then and there introduce such legal testimony of said witnesses as they may see fit, which evidence, when so taken, shall be filed among the records of the court; and the same, or duly certified copies thereof, shall thereafter be received in all suits on said patent to which the said petitioners, or the said defendants, or any of them, or those claiming by, through, or under them, shall be parties; but the witnesses, if living, may be recalled in said suits and re-examined or cross-examined, as the case may be, by any party. And the complainant or petitioner in any such proceeding shall, within twenty days after the filing in court of any such petition, file in the Patent Office a certificate of the clerk of the court, setting forth when and where such petition was filed, together with the date and number of the patent, and the name of the patentee, which certificate shall be entered of record by the Commissioner of Patents in the assignment records of the Patent Office. Any number of persons, whether jointly interested or not, may join in said petition; and if necessary, several petitions may be filed, at the election of the petitioners, in different districts where any other parties interested in said patent reside or may be found. Each party to said petition shall pay the costs of taking his own testimony, but all the costs of the court shall be paid by the petitioners; but the court may, in its discretion, assess upon the complainant or petitioner any part or all of the legal costs, and also a reasonable allowance for travel and attendance: *Provided*, That no depositions taken under this section shall be used, except as against persons who were parties to such proceeding, or those claiming under them by interest acquired subsequent to filing said certificate in the Patent Office; and no such depositions shall be used in any action at law when the witness is alive, competent to testify, and within the United States during any time when his testimony could be regularly taken in the cause.

SEC. 9. Upon the petition of any person interested adversely to any original, reissued, or extended patent, and upon proof that the owners thereof, or persons entitled to bring suits thereon against the petitioner where the owners are not so entitled, have knowledge of infringement thereof, and unreasonably delay or neglect to bring suit in which the validity of said patent may be tried, to the injury of the petitioner, any court of the United States having jurisdiction of patent causes, upon notice as hereinafter provided and due hearing, may authorise such petitioner to bring a bill in equity to declare void said patent, or any claim thereof, for any of the causes which by law may render the same invalid whether relating to the original patent or any reissue or extension. And a decree rendered in said suit, declaring void said patent, or any claim thereof, shall be conclusive in favor of all persons against all the parties defendant in said suit who may have been duly served or appeared therein. It shall be the duty of the clerk of the court where such suit was pending, within twenty days from the rendition of a final decree adjudging said patent or any claim thereof to be void, to make and send to the Commissioner of Patents a certificate setting forth the names of the parties, the date and number of the patent, and the name of the patentee, the number of the claims so adjudged to be void; which certificate shall be recorded by the Commissioner of Patents with the records of assignments, and notice of such decree shall be given in connection with such publications and notices as the Commissioner may make of the expiration of patents.

Such petition and bill shall name as defendants all persons who appear by the records of the Patent Office to be owners of said patent or to have an interest therein, except that licensees holding by licenses not exclusive in their character, as to territory or purpose, need not be made parties.

Said petition and bill shall be brought in the district where a plurality in interest of the owners of the legal title to the patent reside or are found; but if equal interests are held by owners in different districts, each of which is greater than the interests of owners in any other district, then said petition and bill may be brought in either of said districts. Upon the filing of the petition, an order of notice shall issue to those defendants who are found within the said district, and also to those not to be found therein, directing them, on a day therein to be designated, to appear and show cause, if any they have, why the prayer of said petition should not be granted, and to appear, plead, answer, or demur to such bill as the court shall permit to be filed thereupon. And if the court shall allow such petition and such bill to be filed, no additional service shall be necessary upon those defendants who were served under the petition. Such order shall be served in the same manner that subpœnas in equity are now served, or in such other manner as the court may order. If any defendant does not appear, show cause, plead, answer, or demur within such time as the court, by special order or general rules, may prescribe, it shall be lawful for the court, upon proof of said notice and of the performance of the directions contained therein, to entertain jurisdiction, and to proceed upon said petition and bill in the same manner as if such defendant had been served with process within the district, and had made default.

From a final decree in such suit, an appeal may be taken to the Supreme Court in the same manner provided by law for appeals in other patent causes in equity,

SEC. 10. Whenever any person shall be injured by a claim by the owners of any patent, or the parties entitled to sue thereon, or their agents, that he is infringing the same, made publicly or by notice to customers or consumers, and no suit shall be brought and prosecuted to enforce such claim, he may file a petition in equity, in any court of the United States having jurisdiction of patent causes, to compel the person making such claim, or on whose behalf it is made, to bring or cause to be brought a suit on said patent, to test its validity and the question of its infringement by those acts which are so claimed to constitute an infringement. The petitioner shall file affidavits in support of the allegations of the petition, and the court, upon sufficient cause shown, shall order the defendant to appear at a day named, to show cause why the prayer of the petition should not be granted. On the return day of said order of notice, the defendant shall file his answer, with affidavits in defense; and the petitioner may file affidavits in reply within such time as the court may fix. If, upon a hearing on the petition, answer, and affidavits, the court shall deem it just and reasonable, it shall pass an order requiring the respondent to bring a suit as aforesaid, within a time named, and in default thereof to be enjoined from thereafter making or prosecuting in any manner, against the petitioner, or those claiming under him as purchasers of any specific article, machine, or composition of matter, the claim which is found and adjudged by the court to be the basis of the petition; and upon such default, the court may issue an injunction accordingly.

SEC 11. On each and every patent for an invention issued after the passage of this act, there shall be paid to the Commissioner a duty, as follows, namely: Fifty dollars, to be paid on or before the first day of January occurring next after the expiration of four years from the date of the patent, and one hundred dollars on or before the first day of January occurring next after the expiration of nine years from the date of the patent; and in default of any such payment, the patent shall expire on the first day of April next thereafter. But the Commissioner, for good cause shown, may allow the payment to be made at any time before such first day of April, in which case the patent shall not become void. The Commissioner shall annually, in the month of April, publish a list of the patents which have expired for non-payment of duties. Patents issued under this law shall contain a notification of the annual duties to be paid, and the time for such payments.

SEC. 12. Section forty-eight hundred and ninety-eight of the Revised Statutes shall be, and hereby is, amended to read as follows: Every patent, or any interest therein, shall be assignable in law by an instrument in writing; and the patentee or his assigns or legal representatives may, in like manner, grant and convey an exclusive right under his datent to the whole or any specified part of the United States, or an exclusive license thereunder, for any specified purpose or territory. An assignment, grant, conveyance, or exclusive license, as aforesaid, shall be void as against any subsequent purchaser, mortgagee, or licensee for a valuable consideration, without notice, unless it is recorded in the Patent Office within one month from the execution thereof, or before the execution of such subsequent grant, conveyance, or license. And all licenses and all powers of attorney and agreements made under or relating to any letters patent, may, if desired, be recorded in the Patent Office, and any duly certified copy of the record of the same may be used in evidence in all cases where the copy of the record of any assignment so certified may now by law be used.

SEC. 13. When there are two or more joint owners or owners in common of any patent, a license from any one of said owners shall be good and valid in law, and shall vest in the licensee a right to use the said invention, but not exclusively, according to the terms of said license, unless the conveyance or other instrument creating such joint ownership, or ownership in common, recorded at the Patent Office before the execution of said license, shall provide that no license shall be valid unless executed by all of such owners, or a specified portion thereof in number or interest, or unless an agreement to that effect shall be made by said owners and filed for record before the execution of said license,

SEC. 14. Whoever conveys any interest in any patent, or grants any license thereunder, knowing that the interest or right so purporting to be granted or conveyed has been previously granted in whole or in part to another, without, before the payment, either by note or otherwise, of the consideration, or any part thereof, informing the grantee or grantees of the existence and nature of such incumbrance or prior right, so far as he has actual knowledge thereof, shall for every such offense, be punished by imprisonment not exceeding one year, or by fine not exceeding one thousand dollars.

SEC. 15. Section four hundred and seventy nine of the Revised Statutes shall be, and hereby is, amended, so as to read as follows: The Commissioner of Patents, Assistant Commissioner, and the chief clerk, before entering upon their duties, shall severally give bond, with sureties, to the Treasurer of the United States, the first two in the sum of ten thousand dollars each, and the last in the sum of five thousand dollars, conditioned for the faithful discharge of their respective duties, and that they shall render to the proper officers of the Treasury a true account of all money received by virtue of their offices.

SEC. 16. Section four hundred and ninety-three of the Revised Statutes shall be, and hereby is, amended so as to read as follows: The price to be paid for uncertified printed copies of specifications and drawings of patents shall be determined by the Commissioner of Patents, within the limits of actual cost as the minimum, and fifty cents as the maximum price; and the price to be charged for certified copies shall be the same as for uncertified copies, with the addition of twenty-five cents for the certificate and seal.

SEC. 17. Section eight hundred and ninety-two of the Revised Statutes shall be, and hereby is, amended so as to read as follows: Copies of any records, books, papers, drawings, or models, belonging to the Patent Office, and of letters patent authenticated by the seal and certified by the Commissioner, Assistant Commissioner, or Acting Commissioner of Patents, shall be evidence in all cases wherein the originals could be evidence; and any person making application therefor and paying the fee required by law, shall have certified copies thereof.

SEC. 18. Section forty-eight hundred and eighty-five of the Revised Statutes shall be, and hereby is, amended so as to read as follows: The final fee due upon the allowance of a patent shall be paid within six months after the sending of the notice of such allowance to the applicant or his agent, and if the fee be not paid within such time the patent shall not be issued. Every patent shall issue, bear date, and take effect as of a day certain, to be fixed by the Commissioner of Patents, not later than the second calendar week after the payment of the final fee; and until the day of issue the application shall be within the jurisdiction of the Commissioner: *Provided*, that no application on which the final fee has been paid, after notice of allowance shall be withheld from issue because of interference with any application filed subsequent to the payment of the final fee, as aforesaid.

SEC. 19. Section forty-eight hundred and eighty-seven of the Revised Statutes shall be, and hereby is, amended so as to read as follows: No person shall be debarred from receiving a patent for his invention or discovery, nor shall any patent issued subsequent to March second, eighteen hundred and sixty-one, be declared invalid, by reason of its having been first patented in a foreign country upon the invention of the same person, unless the same has been introduced into public use in the United States for more than two years prior to the application; but all applications hereafter to be made for patents for inventions which shall have been patented in a foreign country upon the invention of the same person shall be made within two years after the date of such foreign patent.

SEC. 20. Section forty-eight hundred and ninety-four of the Revised Statutes shall be, and hereby is, amended so as to read as follows: All applications for patents shall be completed and prepared for examination within two years after the filing of the application, and in default thereof, or upon failure of the applicant to prosecute the same within two years after any action therein, of which notice shall have been sent to the applicant or his agent, they shall be regarded as abandoned by the parties thereto.

SEC. 21. Section forty-eight hundred and ninety-five of the Revised Statutes shall be, and hereby is, amended so as to read as follows: Patents may be granted and issued to the assignee of the inventor or discoverer, and they may be reissued to the owner or owners of the entire interest in the patent; but the assignment must first be entered of record in the Patent Office. And in all cases of an application by an assignee for the issue of a patent, the specification shall be signed and sworn to by the inventor or discoverer; and in all cases of an application for a reissue of any patent, the application may be made and the corrected specification sworn to and assigned by the owner or owners of the entire interest in the patent.

SEC. 22. Section forty-eight hundred and ninety-seven of the Revised Statutes shall be, and hereby is, repealed; but in the case of any patent which, prior to the passage of this act, has been ordered to issue, and has been forfeited for non-payment of the final fee, the renewed application provided for by said section may be made within six months from the passage of this act.

SEC. 23. Section forty-nine hundred of the Revised Statutes shall be, and hereby is, amended so as to read as follows: It shall be the duty of all patentees, and their assigns and legal representatives, and all persons making or vending any patented article for or under them, to give sufficient notice to the public that the same is patented, either by fixing thereon the word "patented," together with the year the patent was granted, and number of the patent, or when, from the character of the article, this cannot be done, by fixing to it, or to the package wherein one or more of them is inclosed, a label containing the like notice; and in any suit for infringement, by the party failing so to mark, no profits or damages shall be recovered by the plaintiff, except on proof that the defendant was duly notified of the infringement, and continued, after such notice, to make, use, or vend the article patented: *Provided*, That profits or damages shall not be forfeited for failure to mark the number of the patent or patented article on its label, unless such failure shall occur at a period later than six months after the passage of this act.

SEC. 24. Section forty-nine hundred and four of the Revised Statutes shall be, and hereby is, amended so as to read as follows: Whenever an application is made for a patent, or for the reissue of a patent, which, in the opinion of the Commissioner, would interfere with any pending application, or with any unexpired patent, he shall give notice to the parties in interest, as the case may be, and shall direct the examiner of interferences to proceed to determine the question of priority of invention; and the Commissioner may issue a patent to the party who is adjudged the prior inventor, unless the adverse party appeals from the decision of the examiner of interferences, or of the board of examiners-in-chief, or of the Commissioner or Assistant Commissioner, as the case may be, within such time, not less than twenty days, as the Commissioner shall prescribe: *Provided*, That after the final decision between the parties to an interference, the application of the successful party shall not be put into interference with any application filed subsequent to the closing of the testimony taken on behalf of the successful party in the interference so decided; but the patent shall issue to the successful contestant, and then, if desired by the subsequent applicant or applicants, an interference may be had with said patent: *And provided further*, That in the case of reissues no interference shall be declared with any patent of later date than that sought to be reissued, except when the original application for such subsequent patent is shown by the office records to have been of prior date to the application of the patent sought to be reissued, nor with any application for a patent filed subsequent to the date of the patent sought to be reissued; but, if desired by such subsequent applicant or patentee, on an application for reissue, an interference may be had with the reissued patent after the same shall have been issued.

SEC. 25. All laws and parts of laws inconsistent with the foregoing provisions are hereby repealed.

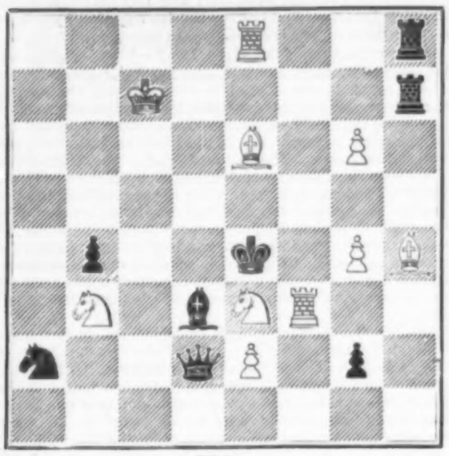
SCIENTIFIC AMERICAN CHESS RECORD.

[All contributions intended for this department, may be addressed to Samuel Loyd, Elizabeth, N. J.]

Problem No. 35. By T. M. Brown.

First Prize.—*Clipper* Tourney No. 3.

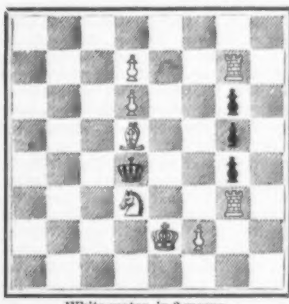
Black.



White.

White to play and mate in five moves.

"MIRON" AND THE CLIPPER PROBLEM TOURNEYS.



White mates in 3 moves.
By Dr. C. C. Moore.

Unaccompanied by a portrait of "Miron" a record of the *Clipper* Problem Tournaments would be incomplete, and yet we feel considerable hesitation in introducing to the public, or dwelling upon the labors and services of one who has been an active member of the fraternity for upwards of a quarter of a century, and whose acquaintance extends throughout the entire chess world. In fact, an extended notice of our old friend would almost necessitate an autobiography of ourself, for our earliest recollections of the game are associated with his pleasant instructions at the odds of a queen, and the boyish pride we felt when he finally passed upon our first problem as worthy of publication. Our old intimacy has survived the various degrees of reduced odds, until the question of strength would be decided a shade in our favor, and the master submitted problematical questions to the judgment of the pupil.

Mr. Hazeltine is most lavish in his admiration for the works of others, but has never essayed to compose a problem nor to acquire fame as a player; he has been satisfied to earn for himself the wide-spread reputation of an honest, liberal, and enthusiastic worker for the cause of chess, who is beloved by the entire fraternity.

We know that we are taking the liberties of a spoiled pupil in criticising the problematical views of our old master, and would not tolerate such impertinence from another, but the art itself, as well as the reputation of our old friend, is too dear to us to countenance such pernicious vagaries as have been embodied in the *Clipper* tourneys, or to encourage a futile but persistent pulling against the popular stream.

Since the first problem was diagrammed, the verdict of public opinion has pronounced strongly in favor of direct problems, in few moves, and every attempt to deviate from the legitimate and correct school has resulted in merited failure. Every suicidal or conditional monstrosity that a composer perpetrates is a blot upon his escutcheon, and it is an injury to the cause of chess to encourage such nonsense by the offering of prizes.

As we have previously shown, the first of the *Clipper* tournaments met with poor success on account of unpalatable features of the programme. The Third Tournament was announced for March 1, 1860, but elicited no competition whatever, on account of the meaningless innovation of "Black to play and mate in —— moves," with the further condition that the king should stand in check, with all of the different resources for defending. The time was extended and a second prize offered which drew a few competitors, and resulted in awarding the first prize to T. M. Brown, and second prize to John Schlesinger, of Cleveland. With the necessary changing of the color of the pieces to avoid useless confusion, we present the winning problem by Brown, regretting, however, that our solvers will search in vain for the marvelous beauties that the enthusiastic Miron is ever pleased to ascribe to it.

The Fourth *Clipper* Tournament was announced May 3d, 1866, being for a prize of a handsome set of chess men and board, offered by the well known problemist, E. H. Courtney, for the best set of two problems in three moves. We are inclined to doubt, however, if it was Mr. Courtney's idea that the gallant knights who rode in this tourney should be seated with "the face to the crupper," but we find the inevitable clog of *black to play and mate* dangling to the conditions of the encounter, as a sure indicator that the *partie* would be select but small.

First prize was awarded to James Patterson, second prize to T. M. Brown, which honors were well deserved. We present one of the winning positions by Mr. Patterson, and regret that our space will not permit us to give the others, as the problems of this tournament were masterly productions, and well worthy of being preserved.

In conclusion, allow us to second a proposition made in the last issue of the *Clipper*, which suggestion is doubly appropriate as emanating from Mr. Hazeltine, the distinguished author and chess *savan*, to the effect that there be an author's prize added to the Association Tourney, to consist of a library of chess books—to be contributed by the several authors—for the best problem of the tournament. The idea is a most happy one, and we trust that every author and publisher will see that his works are duly represented, and will forward the same at once to the Treasurer, Dr. C. C. Moore, 68 Courtlandt St., New York; and we hereby contribute twenty-five dollars to the object, to be invested in such books as the Doctor may find necessary to add to the completeness of the library, and will see that Messrs. Munn & Co. furnish a bound volume of the Supplement.

LICHTENHEIN vs. MONTGOMERY, 1861.

We give this week the concluding game of this famous match, played in Philadelphia, March, 1861. No match since the Stanley and Rousseau contest, in New Orleans, has created such an excitement in chess circles as this encounter between the two representative players of New York and Philadelphia, and since the date of our acquaintance with chess matters we have never known partisan feeling to be so strongly developed as between the two clubs of which the rival champions were their respective presidents. The friends of each were confident of the prowess of their champions, and the players themselves were eager for the fray.

The match was played at the rooms of the Philadelphia Chess Club, the winner of the first seven games to be declared the winner. The result of the match, Lichtenhein 7, Montgomery 2, and one draw, as well as a careful examination of the games, show that the proverbially brilliant play of Montgomery was of no avail against the cautious and close style of Lichtenhein, who was one of the best match players we have ever met.

Both of these famous players are dead, and, if we are not much mistaken, died about the same date, and were very nearly the same age.

MIRON J HAZELTINE.

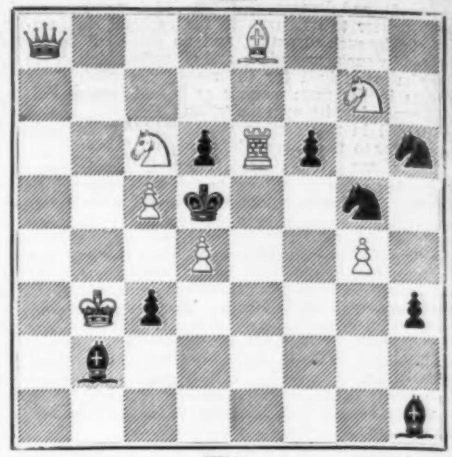
Montgomery. WHITE.	Lichtenhein BLACK.
1. P to K 4	1. P to K 3
2. P to Q 4	2. P to Q 4
3. P x P	3. P x P
4. P to Q B 4	4. B to Kt 5 ch
5. Q Kt to B 3	5. Q to K 2 ch
6. B to K 3	6. K Kt to B 3
7. Q to Q Kt 3	7. Q Kt to B 3
8. P to Q B 5	8. Q Kt x Q P
9. Q to Q sq	9. B x Q B P
10. B to K 2	10. Q Kt x B
11. B x K B	11. Kt x Q Kt ch
12. B x Q	12. Kt x Q
13. B x K Kt	13. Kt x K Kt P
14. B x K Kt P	14. R to K Kt sq
15. K x Kt	15. R x B
16. K Kt to B 3	16. B to K 3
17. P to Q Kt 4	17. Castles.
18. Kt to Q 4	18. B to K Kt 5
19. Q R to Q B sq	19. Q R to K Kt sq
20. P to K Kt 3	20. B to Q 2
21. K R to Q sq	21. K to Kt sq
22. R to B 5	22. P to Q B 3
23. R to R 5	23. P to Q R 3
24. P to Q R 4	24. R to Kt 3
25. P to Kt 5	25. B to R 6
26. P x R P	26. R to B 3 ch
27. Kt to B 3	27. P x P
28. R to Q 3	28. R to Kt 4
29. R x P	29. K to Kt 2
30. R to R 5	30. R to B 4
31. R to Kt 3 ch	31. K to B 2
32. R to R 7 ch	32. K to Q 3
33. P to R 5	33. B to Kt 5
34. P to R 3	34. B x Kt
35. P to Kt 4	35. B x P ch
36. K to Kt 3	36. B to Q 8
37. K to Kt 2	37. R to B 6 ch
38. K to Kt 2	38. R to Kt 3 ch
39. K to R 2	39. R to B 8
40. R to K Kt 2	40. R to R 3
41. P to R 6	41. B to B 6
42. R to Kt 5	42. R to R 8 ch
43. K to Kt 3	43. R to Kt 8 ch
44. K to B 4	44. R to R 5 ch

45. K to B 5, and resigned, Mr. Lichtenhein having a forced mate in twelve moves

Problem No. 36. By James Patterson.

First Prize. *Clipper* Tourney, No. 4.

Black.



White.

White to play and mate in three moves.

SOLUTIONS TO PROBLEMS.

No. 29.—By T. M. Brown

WHITE.	BLACK.
1. K to K Kt 5!!	1. K to K 3 dis ch
2. Kt to K B 5!!	2. Any move
3. Mates accordingly.	
	1. K to Q 5 dis ch
2. Kt to K B 5 dis ch	2. K moves
5. R to Q 4 mate.	
	1. R x B
2. Kt to Q Kt 5 ch	2. K moves
3. R or B mates.	

No. 30.—By T. M. Brown.

WHITE.	BLACK.
1. Q x B	1. K to Q 3
2. R to B 7	2. K to K 4
3. Q to Q B sq	3. Any move
4. Mates accordingly.	
	2. Kt moves
3. Q to B 7 ch	3. P x Q
4. Kt to B 4 mate.	
	1. K to Q sq
2. Q to Q R 8 ch	2. Kt to B sq
3. Kt to Q 5	3 Any
4. Mates.	
	1. K to B sq
2. R x Kt	2. K to Q sq
3. Kt to Q 5	3. Any
4. Mates.	

Letter "M."—By E. B. Cook

WHITE.	BLACK.
1. Q to Q 5 ch	1. Any move
2. Mates.	

CHESS PROBLEMS.

To show that our views in regard to stratagems in few moves are not based upon mere personal preference, we quote the views of some eminent authorities on the subject, and, did our space permit, could prove that such have been the views of all the leading players, writers, and problemists.

Carrea says: "End games cause much delight on account of the ingenuity displayed in them, and are much sought after by amateurs." And in speaking of their beneficial effects upon the chess-player, he says: "That many players of indifferent skill have acquired great celebrity from their knowledge of some positions which they have won, and have made better players feel ashamed. Besides, who will deny that the mind is awakened and incited to victory by ingenious positions?"

Staunton says: "To play with correctness and skill the ends of games, is an important but a very rare accomplishment, except among the magnates of the game."

Boden says: "Problemists possess the glance of a lynx in particular situations, and are able to detect an ingenious mate of several moves deep with remarkable quickness."

The study of the best problems by the best masters will amply repay the student, inasmuch as it will teach him the quickest and most brilliant method of playing the ends of games. It will also have the beneficial effect of teaching the tyro never to despair; for he will often find that, in hundreds of situations, the inferior may win.—*C. Kenny.*

Playing is the prose of chess, problems are its poetry. Sparkling positions, terminating in a few moves with a brilliant mate, are the lyrics of this art, while deeper stratagems in many moves, and requiring long study, may be properly compared to the stately epic.—*D. W. Fiske.*

The study of problems is necessary for those who wish to learn chess. They show the innumerable resources of the game, and what is more important, they accustom the student to calculate several moves in advance; they consequently form a chess-player, and strengthen his game, because at chess the ability of a player is enhanced in proportion to the number of moves he can foresee.—*Chess-Player's Chronicle.*

The study of problems forming ends of games won or drawn by masterly moves, has always been considered by the best chess-players and writers eminently useful, if not absolutely necessary towards forming the finished player.—*H. R. Agnel.*

The best problems are those having the fewest moves and fewest pieces. A puzzle in three moves is far superior to the finest stratagems in five.—*D. Julien*